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# BOMBAY NATURAL HISTORY SOCIETY

Vol. 53, No. 1

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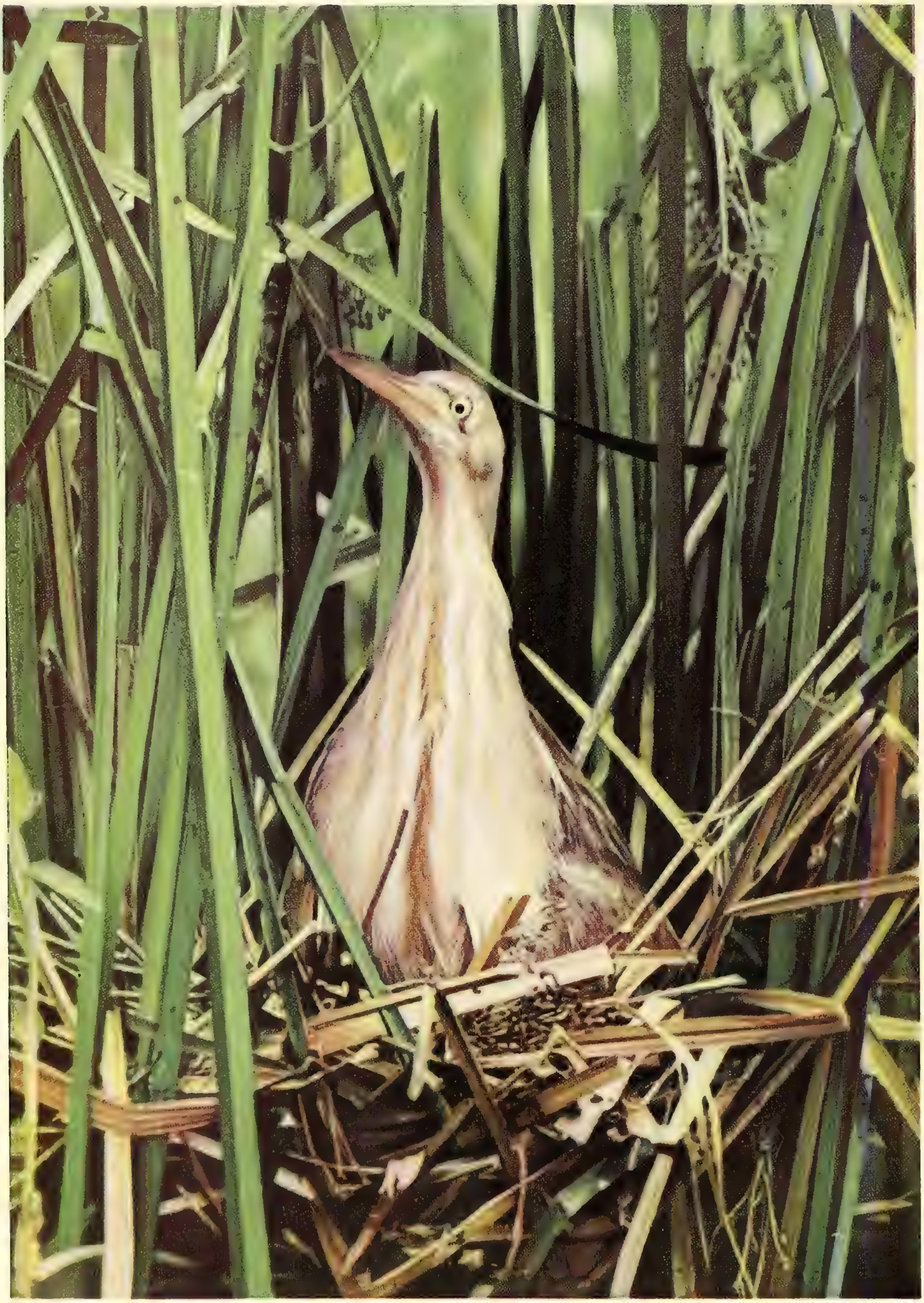

*Kodachrome* *Loke Wan Tho*

The Chestnut Bittern
(*Ixobrychus cinnamomeus*)
Male

JOURNAL

OF THE

BOMBAY NATURAL HISTORY SOCIETY

1955 Vol. 53 No. 1

# TWO BITTERNS IN A PENANG MARSH

BY

LOKE WAN THO

## PART II

(*With 1 coloured and 4 black & white plates*)

(*Continued from Vol. 52, p. 691*)

### THE CHESTNUT BITTERN (*Ixobrychus cinnamomeus*)

During the weekend in August when the Yellow Bittern had been successfully photographed, I had noticed in the same area a number of Chestnut Bitterns whose spectacular plumage—of a colour better described, as 'chestnut' than 'cinnamon'—had made them more conspicuous than their cousins. Less shy and retiring, they could be admired as they stood in the open in some patch of the ricefield where the *Scirpus* grass had been cut. Not until an intruder came really close did they take wing, and then it was that the bright brown-red of their plumage could best be admired.

Most authorities speak of the bird being crepuscular and shy, but Smythies makes an interesting observation:

'This species is neither crespuscular nor shy in the breeding season, when it becomes conspicuous and flies about in broad daylight, but during the rest of the year it is secretive and not often seen.'[1]

Smythies goes on to quote Stanford who 'once watched a male bird displaying at midday, flying in front of the female with very slow, stiff beats of the wings, which reminded me of the nuptial

---

[1] *Note*: One of the Malay names for the Chestnut Bittern is 'burong gelam', i.e., bird of the gelam tree (*Melaleuca leucodendron*). What connexion our bittern has with the familiar tree with the beautiful white bark, it is difficult to imagine, unless perhaps that *Melaleuca* grows best near water, in marshy places close to the sea. Had the word been 'kelam', instead of 'gelam', the meaning would have been perfectly clear: 'kelam', according to Wilkinson's Malay Dictionary means 'darkness, gloom or obscurity'.

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flight of a long-eared owl or a greenfinch'. Stanford also added that the Yellow Bittern sometimes behaves in the same way.

The Chestnut Bittern is 'widespread in the oriental region, and also in north-eastern Asia'. It is a bird of the swamplands, but may be found up to quite surprising heights above sea-level: thus, in north-eastern Burma, it has been recorded at 6,000 feet, and Sálim Ali saw it in the vicinity of Periyar Lake, Travancore, at about 3,000 feet.

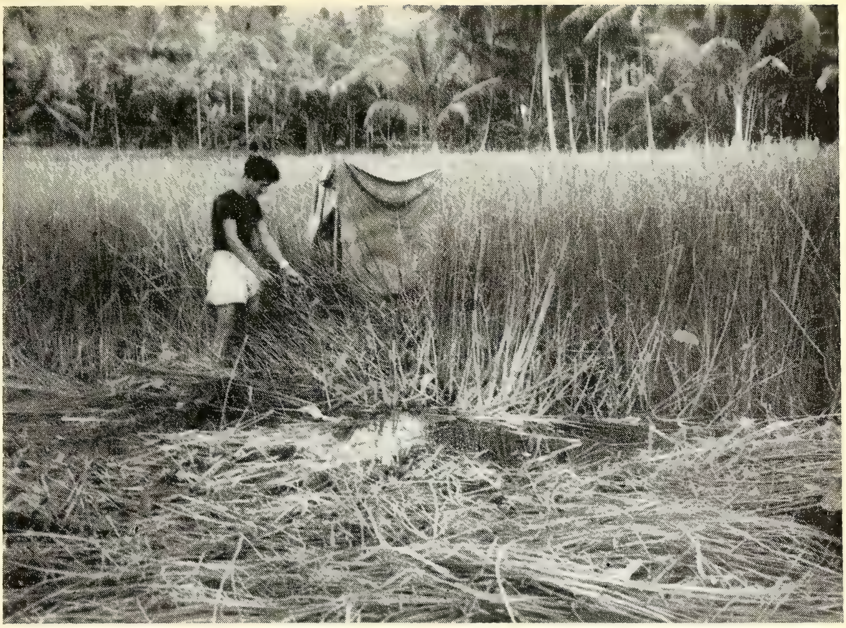
Nests are not easily found, unless one is prepared to go tramping through the marshes. There is a Malay belief that because the nest is so difficult to find anyone who wears it on his head becomes invisible: (See Chasen, 'Birds of Singapore Island', page 91). I resolved, however, that I would try to photograph the bird, not only in black-and-white, but if possible also in colour. Mr. Cairns once more generously offered to help, and in due course, the eagerly-awaited news came that a nest had been found. As soon as I could disengage myself from the office, I flew to Penang, arriving at just after 11 a.m. on the morning of Friday, September 17th. We went straight out to the reed-beds at Ginting: on the way, we picked up two soap-boxes, one for me to sit on, and the other to serve as a table for my heavy camera case.

The first nest we inspected contained four young birds, already so large that they clambered out of the nest at our approach, and in so doing got themselves thoroughly wet by falling into the water. It would have been useless to attempt photography here, so we tried another nest which was situated about 40-50 yards away. In it were four eggs, very clean and white, and so fresh that they looked pale pink in the sunshine: the last egg of the clutch, Mr. Cairns told me, had been laid only the day before.

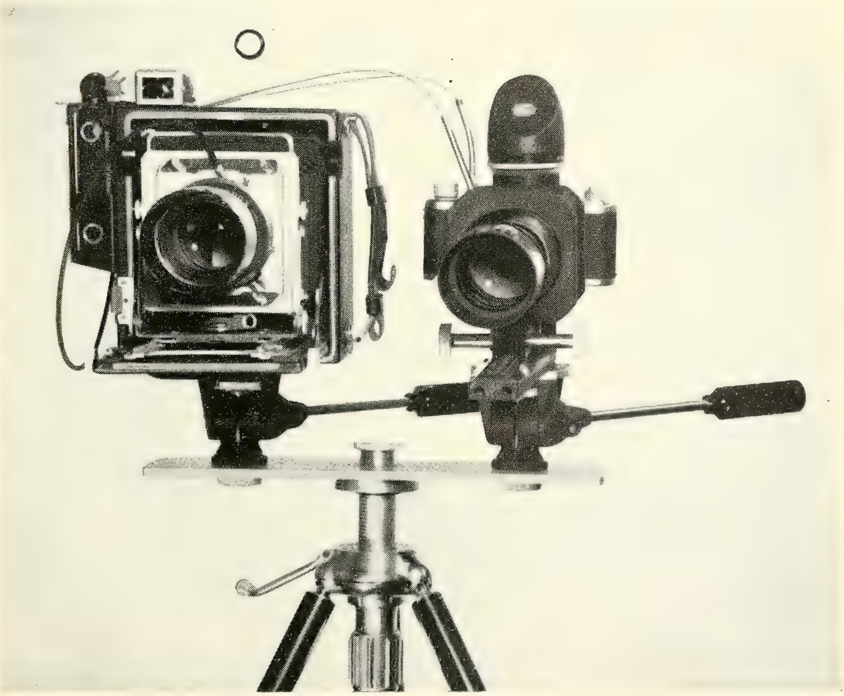
All three of the nests which I have had the good fortune to see in Penang were of identical construction, consisting of a heavy flattened pad of reeds and grass, mixed with a few slender sticks and rootlets. None was placed more than 12 inches above the level of the water. Other writers have, on the whole, found the same thing, but there are a few records of unusual sites. Stuart Baker quotes Colonel Butler's description of a nest in Belgaum which, consisting of 'a tolerably substantial pad of short pieces of coarse, damp sedge, lined with pieces of dry grass, was built upon a small plot or rising ground in the middle of an inundated cornfield. The island was covered with grass about a foot from the ground, and some 9 or 10 feet from the water's edge'. La Touche, writing about the birds of Eastern China, refers to a pair of birds at Mengtsz where they were found to 'breed in the Commissioner of Customs's garden in a rose-arbour, the nest being placed several feet from the ground, and the young hatch out about the middle of June'.

Stuart Baker was of the opinion that the Chestnut Bittern is bolder than the Yellow Bittern, and speaks of having found its nest in the Botanical Gardens at Calcutta. Smythies, too, found a nest in the Botanical Gardens at Maymyo, in Burma.

Profiting from the experience gained on my previous visit when I had failed to obtain colour pictures of the male Yellow Bittern because I had used only one camera at a time, I had now brought

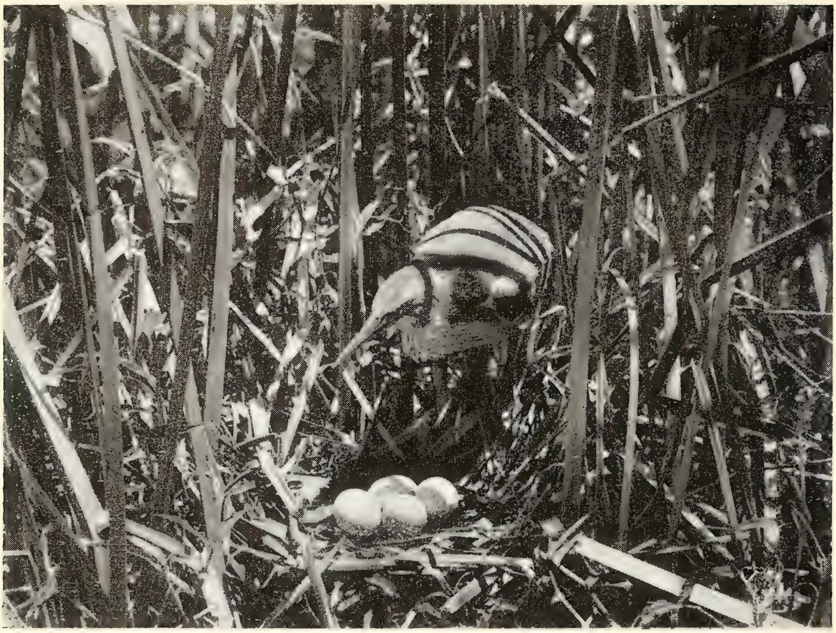


Ralli and the hide set up in position at the Chestnut Bittern's nest.

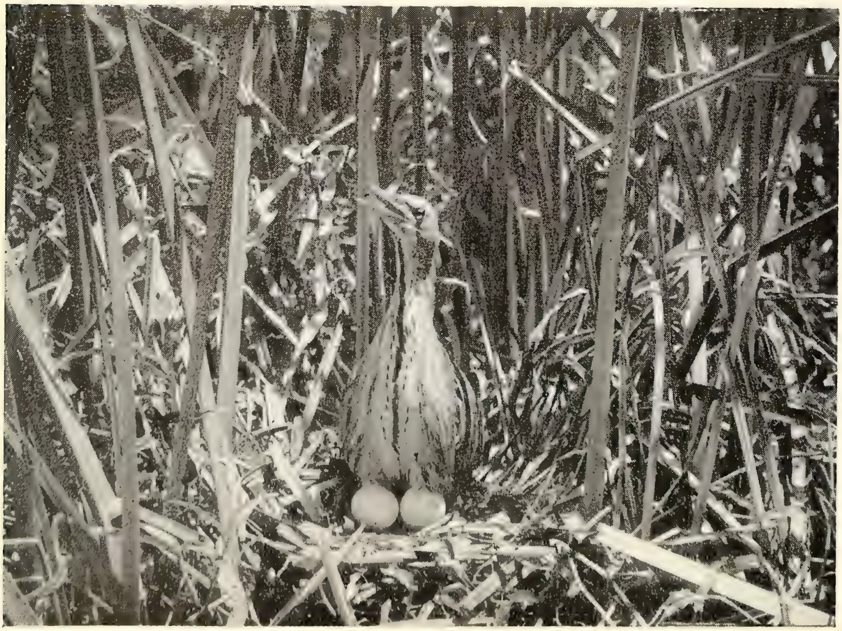


The twin mounting for the cameras to enable black-and-white and colour photographs to be taken simultaneously.
*(Photos: W. T. Loke)*

CHESTNUT BITTERN, (FEMALE)



"... . the fierce sun laid black weals on her back."



" .... like brown thread stitched on coarsely .... "
*(Photos: W. T. Loke)*

with me a new gadget, made by my assistant Hwang, which allowed two cameras to be used together on the same tripod. The cameras—a quarter-plate Speed Graphic and a Leica with a 20 cm. lens—were each mounted on its own pan-tilt head, and we had feared that their combined weight might have proved too much for the single tripod, but, fortunately, it remained rock-steady. How successful I was in its use, the story which follows will tell.

Inside the hide, it was fiendishly hot. The sun poured like molten lead out of an unclouded sky. This was not only unfortunate for my own comfort, but it caused the reeds to cast heavy shadows which lay like black ribbons across the nest.

The female began creeping stealthily back soon after my helpers had left me: a long neck rose up behind the nest, and a yellow eye looked fixedly in my direction. Unable to detect any suspicious movement, she lowered her head, and with deliberate steps moved quietly and stealthily forward. Her yellow-green feet made only a faint splash in the water, and the body, laterally compressed to facilitate her passage through the reeds, rustled them so gently that I could not be sure if I had really heard a sound, or had merely imagined it. Before long she stepped on to the nest which was not more than 8 inches above the level of the water. The shutters of the two cameras clicked almost simultaneously, but the bird paid no heed, and it was only when I made too much noise tearing off the paper tongue of my filmpack that she rose and slipped into hiding: she soon came back and I exposed one film after another in quick succession.

The chestnut back of the female made a sharp contrast with the bright colour of the underparts. Down the middle of her breast there was a heavy streak, dark brown in colour, and on either side were finer streakings that looked like brown thread stitched on coarsely. As in the case of the Yellow Bitterns, the Chestnut Bittern had a patch of dark feathers with pale brown edges on each side of the breast. A similar patch was later noticed also in the male.

The female bird never became reconciled to the noise of paper being torn from the filmpack, and after some two hours it was clear that she was becoming more and more nervous, and so I decided to leave her in peace. The photographic session ended at 4 p.m. without my having had a single glimpse of the male. The pictures of the female, both in colour and black-and-white, turned out passably well, but would have been better had the fierce sun not laid black weals on her back.

The next morning I returned to the same nest to try and get a picture of the cock bird which I hoped would by then be taking his turn at incubation. Within minutes of my helpers leaving me, there was a faint sound of dripping water and of a 'noiseless noise' within the reeds. Again, a long neck stretched up cautiously and its owner took a deep look at the hide; the examination proving satisfactory, the bird began to approach the nest and would have eventually stepped on if, at that very moment, Ralli had not returned for his 'parang'[1] which he had left behind on a nearby bund. Like a flash, the bird disappeared. The interruption was doubly unwelcome because I had seen enough to realise that it was the male who had shown himself. Fortunately, no great harm was done, and before long the routine of inspection was repeated.

---

[1] 'parang' (Malay) = long-bladed knife.

I waited for the male to use the same back-door route as the female. All the grass in front of the nest had been cut only that morning—indeed, we had arrived in the nick of time to prevent further damage—and when the bird stepped out into the open and clambered on the nest from the front, the action was totally unexpected. The male had evidently been in the habit of approaching the nest by a different route to that of his mate, and now, despite the lack of cover, force-of-habit made him take the same path. However, it was clear that he felt uncomfortable, and on subsequent approaches he adapted himself to the changed circumstances and walked on, either from the side, or from the back. The bird had, throughout, moved deliberately, and with almost complete absence of noise: only once did he stumble, when a reed gave way under him, and the sound it made in the silence was like the crash of a tree falling in the jungle.

During the time when the Chestnut Bittern had been making his quiet approach to the nest, a pair of Rails (*Rallus striatus*) were behaving in quite the opposite manner. They chased each other through the reeds, making loud trilling sounds as they did so. I got a glimpse of one bird as it slipped through the grass in front of the hide; the upper part of the body was dark grey, and the head and bill a lovely shade of red.

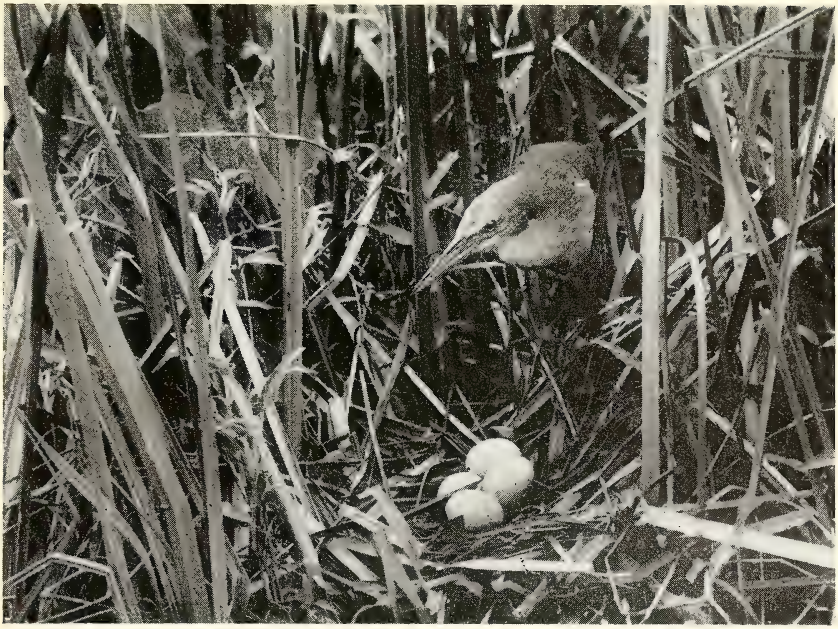
The Rails were not the only visitors. A young Yellow Bittern also came very close to my hide, so close indeed that a quick movement I made inside sent it scuttling away. Looking dapper in shiny new feathers, it flicked its little stump of a black tail constantly up and down like a waterhen. The long, thin neck was frequently stretched out, and the tiny crest, in which black feathers were already showing, was often raised. It never left the area and was my constant companion.

A Yellowbellied Wren-Warbler (*Prinia flaviventris*), too, appeared within the arc of my vision. It sometimes came so close that I was able to admire the yellow wash on its vent, and the white ring round the red eye. It looked handsome in a dress of new feathers, and every reed was assiduously searched for insects.

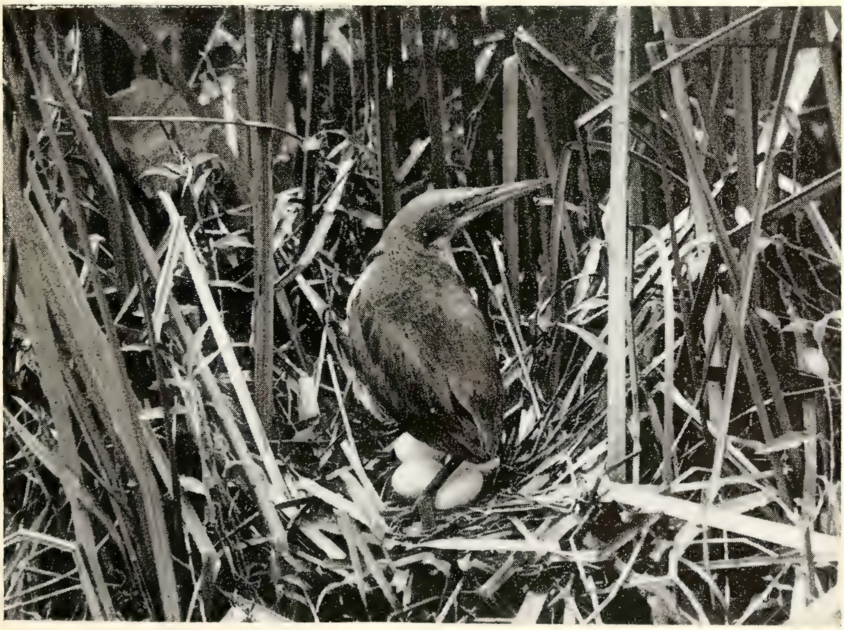
Finally, another bird of equally fine feather, made a quick visit: this was a Fantail Warbler (*Cisticola*) whose noisy clicking I had heard in the distance all morning.

I noticed that the Chestnut Bitterns, unlike their cousins the Yellow Bitterns, did not stretch out their necks in imitation of a reed whenever danger threatened, but instead preferred to crouch.

The cock bird was more richly coloured than the hen. He, too, had a chestnut line down the centre of the breast, but the 'perforated lines' on either side were missing. The base of the mandibles, as also the bare skin in front of the eye, was a beautiful rosy red. The culmen was black, and the rest of the bill a light orange-yellow. I was glad the double mounting on the tripod was working satisfactorily, thus enabling me to obtain a series of coloured pictures, Chestnut Bittern, (male)

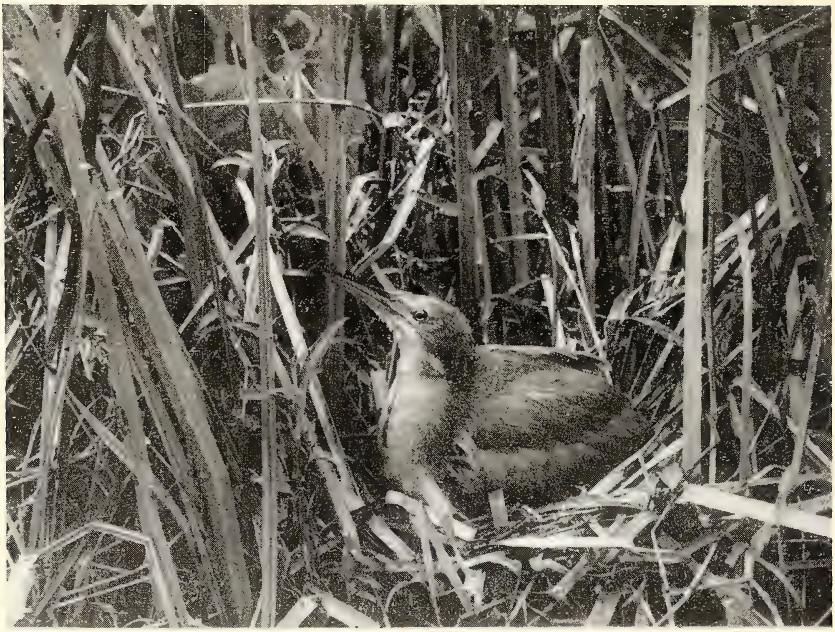


The male slips through the reeds with his body laterally compressed.

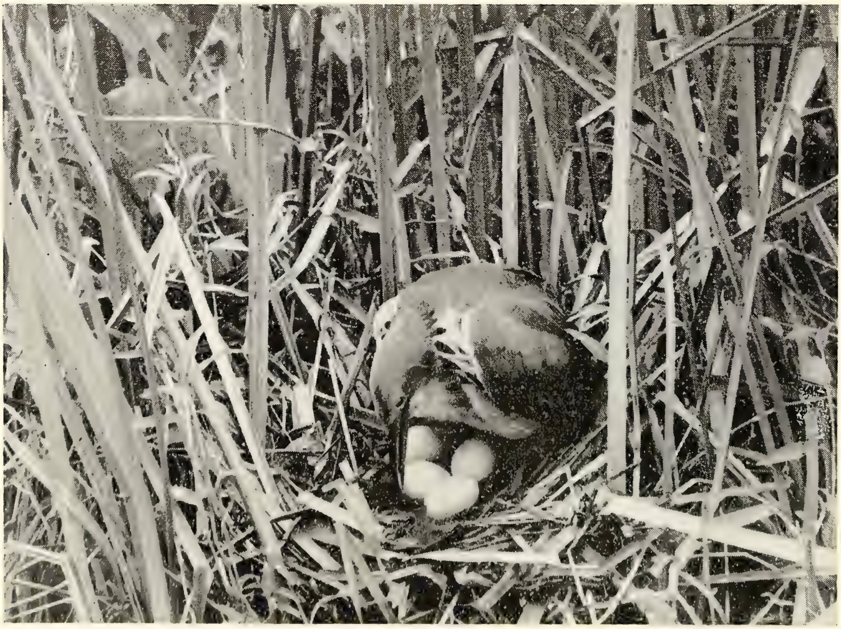


Male and eggs.
*(Photos: W. T. Loke)*

CHESTNUT BITTERN, (MALE)



"...... raindrops lying like globules of quicksilver on the back of the bird ...."



Turning over the eggs.
*(Photos: W. T. Loke)*

in addition to the black-and-white. The bird showed little sign of fear, and I was able to take a large number of pictures. Instead of the harsh sunshine of the previous day, light clouds on this occasion obscured the sun sufficiently to give me a lovely soft illumination. Later in the morning, heavier clouds spread over the sky, until, at noon, rain began to fall. I stayed long enough to obtain pictures of the rain drops lying like globules of quicksilver on the back of the bird, and then it was time to gather together my equipment, and make a dash for it before the full fury of the storm broke.

When I went to Penang, quite apart from playing truant from my office, I was also playing truant from my job as a committee member of the Singapore Turf Club, and by missing the Gold Cup race had, as it were, traded 16 horses for 2 Chestnut Bitterns, so, good readers, I must leave you to judge—do you not think that, by getting the bird, I had also got the best of the bargain?

# A NOTE ON *APANTELES FLAVIPES* CAM., A BRACONID PARASITE OF THE CHOLAM STEM BORER *CHILO ZONELLUS* SWINH.

BY

K. C. Chandy, M.A., Assoc. I.A.R.I.,

*Agricultural College and Research Institute, Coimbatore*

(*With one text figure*)

## Introduction

*Chilo zonellus* Swinh. is a serious stem borer of Cholam (*Andropogon sorghum*,) and occasionally of maize in South India. It is fatal to the plant in the early stages of the crop, but only retards its growth in older stages. When the old plants are attacked at the base they are also liable to be adversely affected by wind which breaks the stem at the point weakened by the tunnel bored inside. The incidence of the borer in the sorghum fields of the Government Central Farm, Coimbatore, is on an average 45–60% of the plants. Chemical control of the stem borer is difficult, and very little work has been carried out so far to find suitable parasites for controlling the pest. The present investigations have been conducted to study the incidence and the breeding habits of its predominant parasite and to examine the scope for its utilisation.

## Material and Methods

The sorghum borers were collected from the infested plants grown in the Central Farm area of the Agricultural Research Institute, Coimbatore, for about two years, and regular observations were made on the incidence of the parasite on the borers. All the borers and parasite cocoons collected from the infested sorghum stems were kept in suitable jars for the emergence of the parasites. *Apanteles flavipes* Cam. was noted to be the most predominant parasite. Other parasites such as *Stenobracon* sp., a *Microbracon* sp. and a Bethylid were also noted though in negligible numbers. It was found that 5–35% of the borers collected were parasitized by *A. flavipes*. The maximum percentage of parasitization by *Apanteles* was noted towards the last week of June and the beginning of July in the 1948 crop, and towards the beginning of March in the 1949 crop.

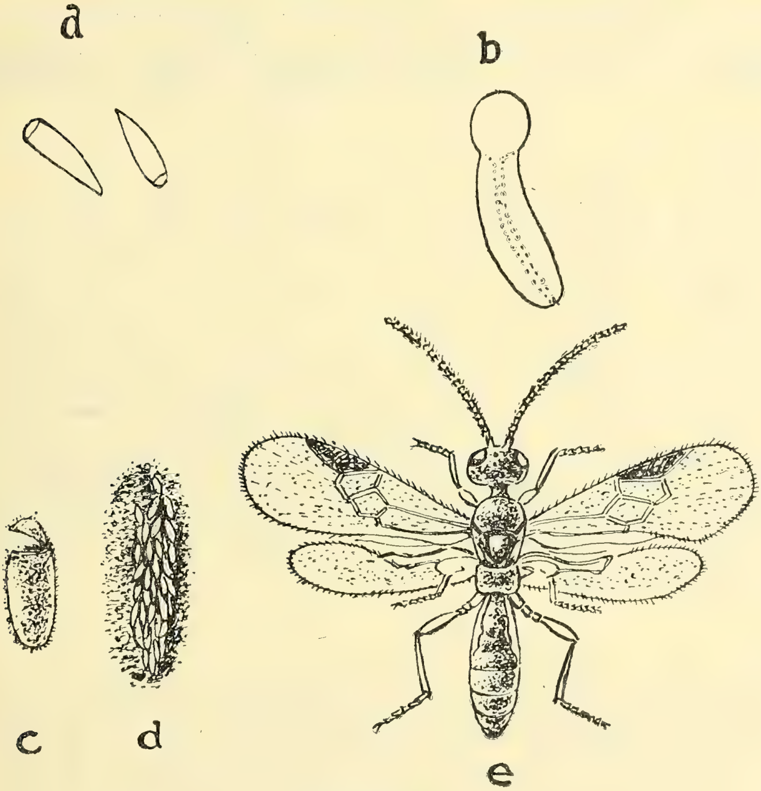
Most of the earlier workers have noted this parasite on sugar cane borers. H. S. Pruthi (1934) and Subramanyam, T. V. (1939) have noted the parasite on *Argyria sticticraspis* H. and *Diatraea venosata* Wlk. Moutia (1936) and Jepson, W. F. (1938 and 1939) have noted it on *Diatraea venosata* and *D. mauriciella* Wlk. respectively. Cheriyan, M. C. and Subramanyam, C. K. (1942) have recorded the parasite on *D. venosata* and Narayanan, E. S. (1936) has recorded it on *A. sticticraspis*, *D. venosata* and *Chilo zonellus* at Pusa.

## Nature and Activities of the Parasite

The adult is a small black insect about 2–2·5 mm. in length. This species is described by D. S. Wilkinson (1928–29) in the reference cited. The males can be identified from females easily by the longer antennae.

The adults get attracted to the infested sorghum stalks and enter the lumen made by the borer to get at the host. For observing the actual process of oviposition, a sorghum stem with a borer partly exposed outside was kept in a glass jar. A few adult parasites were introduced into the jar which was covered up with a muslin cloth. The female oviposited by alighting on the body of the borer and finishing the operation within one or two seconds with a thrust of the ovipositor into the body. The host seemed to be irritated during the process of oviposition and was trying to get away from the parasite by boring further into the sorghum stem. All the female parasites made an attempt to oviposit on the only host available. So it is probable that in nature too a single host may serve as host for egg laying to a number of parasites. From external characteristics it was not possible to identify parasitized caterpillars. But it was observed that the parasitized borers feed more voraciously than the healthy ones.

The eggs were noted by dissecting out a caterpillar immediately after the parasites had oviposited. The egg (Fig. a) is ovoid with one end



Text Figure

Life History Stages of *Apanteles flavipes* Cam.

a. Eggs (× 56)
b. Larva (× 10)
c. A cocoon (× 9)
d. A cocoon mass (× 2)
e. Adult (× 25)

tapering to a point and the broader end with a lid-like covering. It is almost transparent. The larva is pale white with a more or less transparent body. A fairly grown up larva is 2·25 mm. long and 0·5 mm. broad at the caudal vesicle which is the broadest region. The caudal vesicle is a characteristic appendage of Braconid larvae, and it serves as a respiratory organ. When fully grown, the larvae come out of the body of the host and pupate in a cluster of cocoons and are usually found inside the lumen of the stem bored by the host.

After the emergence of the parasite larvae prior to pupation from the host-body, the host survives for some time but is very sluggish and it also has brown spots all over the body. The host does not feed after this and dies a lingering death within about five days. A parasitized host never pupates.

TABLE I.

* BROOD STUDY OF *Apanteles flavipes* CAM.

| Date of emergence | Broods | Total No. of adults emerged | Number of females | Number of males | Percentage of females |
|---|---|---|---|---|---|
| 15-6-48 | 1st brood | 24 | 21 | 3 | 88% |
| 1-7-48 | 2nd brood | 43 | 36 | 7 | 84% |
| 20-7-48 | 3rd brood | 36 | 31 | 5 | 73% |
| 8-4-49 | 4th brood | 18 | 16 | 2 | 89% |
| 29-4-49 | 5th brood | 37 | 36 | 1 | 97% |
| 20-5-49 | 6th brood | 40 | 34 | 6 | 85% |

The pupal period is 3–5 days. Each brood of parasitic larvae emerging from the body of a single host and pupating, consists of from 20 to 45 cocoons. The majority of these give emergence to adults excepting for a few spoilt cocoons. About 75—97% of the total adults emerged are females (Table 1). In the laboratory, adults fed on sugar solution lived from 3–7 days.

## DISCUSSION AND CONCLUSION

*Apanteles flavipes* Cam. is the most predominant parasite of *Chilo zonellus* at Coimbatore, though the present incidence of the parasite in nature is not sufficient to control the sorghum stem borer early enough to avoid its damage to the crop. The higher percentage of females in the progeny should serve as a valuable factor for the parasite to increase the chances of its survival by at least some of the females finding a suitable host to parasitize within the limited period of their longevity. A suitable method of propagating the parasite on a large scale in the laboratory on some easily procurable host has to be found out first. Utilising the parasites by liberating them in the sorghum fields during the early stages of the pest incidence might serve to control the pest to a great extent. Preliminary experiments made by the author to breed the parasite on *Corcyra cephalonica* Staint, and *Spodoptera mauritia* B. were not successful.

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* A group of parasites emerging from a single host is reckoned as a brood.

## SUMMARY

Investigation regarding the incidence of parasites on *Chilo zonellus*, the sorghum borer, revealed that *Apanteles flavipes* was the most predominant one in nature. The life history and habits of the parasite have been studied under laboratory conditions. Preliminary experiments for the mass propagation of the parasite on two easily procurable hosts were not successful.

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# A BOTANICAL EXCURSION TO NORTH KANARA, BOMBAY STATE, IN MAY 1954

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## INTRODUCTION

In May 1954 the writer and a party of friends spent some three weeks touring in North Kanara; these pages consist mainly of the diary of this excursion. The party consisted of Dr. F. A. Kincl representing Syntex S. A. of Mexico; Dr. R. P. Patil, the Forest Botanist, Bombay State; Mr. Wagh, the assistant of Dr. Kincl; Mr. R. Asrana, an M.Sc. student, Bhavan College, Andheri, Bombay; and the writer with two servants.

The aim of the outing was mainly to study and collect medicinal plants from North Kanara; but in addition we were out to study the Evergreen Moist Forest, the only real portion of virgin forest left in Bombay State. We made a very extensive collection of plants, which has not yet been worked out, and took ample notes and photos; on such notes and photos this paper is based. I shall give my impressions in the shape of a diary, since this is the way I entered my notes in my private book.

*15 May, 1954, Saturday.*

Left Bombay yesterday evening by the Deccan Queen; at Poona shifted to the metre gauge for Hubli. Fortunately we had made our reservations and the journey was as comfortable as one can expect in a very shaky toy train. Reached Hubli at about noon of today and went out trying to get some lunch in town. The place does not seem to cater for visitors, for in the whole town there is but one passably good restaurant.

Hubli bus station was very hot, incredibly crowded and very dusty. The waiting room of the station consists of a small open shed with a few benches, perhaps enough to seat about twelve persons; the rest of the waiting passengers had to sit on the ground or fend for themselves, there were well over a hundred people awaiting the various buses that start from Hubli. My party spent three hours waiting in the station, and causing much admiration particularly on account of the shiny aluminium vascula, or boxes for the collection of plants. At 4 p.m. we set out for Sirsi by bus; we were tightly packed in the bus, but by evening the temperature had cooled down considerably. The engine of the bus gave us much trouble all the way to Sirsi, and had to stop in various places to repair some of the minor ailments of the machine. Reached Sirsi at 9-15 p.m., very tired, dusty and rather hungry. At 7 p.m. on the way we had the first downpour of the monsoon, a very violent storm that lasted for nearly one hour.

*16 May, 1954, Sunday.*

Last night was peaceful in spite of large numbers of very hungry mosquitoes; we were too tired to notice such a small thing as the mosquitoes.

In the early morning went out near the forest bungalow and had the first glimpse of the forest in North Kanara. A large tree near the bungalow had all its branches covered with an interesting species of *Drynaria*, a climbing fern with mighty rope-like stems; the abundance of mosses showed that we were in a tropical moist forest. We collected two interesting orchids in flower, and two species of *Loranthus* that were being seen by me for the first time. Yesterday along the road in the twilight we saw a number of plants of *Mussaenda frondosa* in flower, with their ghostly white calyx segments; this morning noticed another large shrub of the same plant with much larger white calyx than what one sees nearer Bombay. The ground under the forest trees was covered with masses of *Elephantopus* and *Mimosa pudica*, the latter in plenty of flowers.

For the first time we were struck with the large number of epiphytes in this type of forest. *Heptapleurum venulosum* is very abundant near the bungalow, in bud and flower or fruit; very large masses cover more than half of a large *Ficus* near the road that leads to the bungalow; the plant is remarkably similar to the European Ivy in its flowers and fruits.

In the open ground in the middle of the compound noticed a small species of *Curcuma*, with just one flower per plant; the corolla is pure white with a broad yellow stripe in the middle of the lip. *Santalum album* is in full bloom near the house; they are small trees about 25-30 ft. high, the petals of the flowers being of a dark purple brown, very similar in colour to *Iphigenia indica* seen in more northern parts.

At noon the public bus company called at our place to pick us up and take us to Jog; I was informed that such a company is one of the few still in private hands, and in consequence they could oblige us by picking us up from our house, a thing the State Transport would not be allowed to do.

The way from Sirsi to Siddapur and Jog is very impressive; majestic trees on either side of the road forming dense forests, though there are already many patches from which the forest has been locally removed. *Hopea* is a glorious sight, very large trees with crimson red fruits, and masses of them; the little *Curcuma* seen at Sirsi is very common and in places very abundant along the road, generally in the undergrowth; the flowers vary from pure white to fleshy pink, and their number from one to about seven per plant, no leaves seen.

Just after milestone No. 11 from Sirsi, we came upon a plantation of *Areca catechu*; the trees composing the plantation are very tall and slender, placed rather closely, with occasionally bananas, *Piper betle* etc., cultivated in the ground below *Areca*. On the trees we noticed a number of epiphytes and not a few parasites. The stems of *Areca* trees are whitish, and the sight of the plantation is very impressive.

The road is good all along except for about a quarter of a mile near the areca plantations; at that spot it was very bad. After a short stop at Siddapur for tea and provisions, we went up to Jog, where we reached at about 5 p.m. From the moment of landing from the bus one is nearly deafened by the noise of the falls. The bungalow, belonging to the P.W.D., Bombay State, is on a hill overlooking the falls; just across the

the deep chasm of the falls is Mysore State bungalow, and about half a mile lower down along the stream is the Mysore Hydro-electric Power Station. As we sat on our vantage point near the Falls, the view was almost overpowering; the drop is 597 ft. high; occasionally clouds of mist are wafted up by the streams of air that come canalised by the river; the falls are facing due west.

The river is the Swarua Nadi. Geologically the bed of the river consists of a large number of strata all inclined about 45 degrees from the horizontal; the stream of the river is divided into several smaller streams by the slanting strata, and thus in place of one might fall along the main course of the river, we get four very beautiful ones, even though smaller. The formation and appearance of the various falls are clearly dependent on the strata of the river bed. The biggest fall, *Rajah*, is not visible from the Bombay bungalow, and is made by the main stream of the river; the next fall, *Roarer*, comes down more or less hidden away by the configuration of the hill for about half its length, then it just jumps into the same basin as Rajah. The third fall, *Rani*, is so called because it is supposed to look like the tresses of a woman spread over the shoulders. The fourth and furthest from Bombay bungalow is the *Rocket*, the most impressive of the lot from the Bombay side. One of the interesting shows near the falls, looking at them from the edge of the Bombay side in front of the bungalow, is that a number of rainbows fringe the base of the falls, at times I counted three such rainbows.

At night the Mysore side is lit with electric lights, from the hydro-electric power house near the bungalow; during the night two powerful spotlights are focussed on the falls from about half way down the slope; these lights bring out the beauty of the falls in a striking manner particularly in moonless nights.

Went to bed at night with the roar of the falls still filling our ears; during the night on waking up, the same roar is the first thing to impress itself on one's consciousness. Gradually the noise becomes so powerful that it gets on one's nerves, and excursions away from the falls give a welcome silence and rest.

In the evening some of our party amused ourselves reading through the Visitors' Books in the Bombay bungalow. One of the recent entries is by Joaquim Alva of Bombay, who remarked that the Bombay Government seems to have made it almost impossible for visitors to come to Jog, to judge from the poor transport facilities and the sort of accommodation provided for them in the State bungalow. Older visitors left more interesting remarks, particularly on subjects such as animal life in the neighbourhood of the falls. It may be of interest to the readers to copy a few of the more striking remarks.

*Vol.* 2, 1878, *page* 21: I met a planter who had been shikarring and had met antelope, bustard, florican, rock grouse etc.

*Vol.* 2, 1882, *page* 70: Within the last 15 days about 20 head-loads of fish were taken out of the river a little below the falls by poisoning the water.

*Page* 78: The pools are teeming with fish . . . Let some one bring a collapsible boat or a wicker coracle and fish in the centre of the big pool. He will, I feel sure, catch monsters: a young swallow will make a good bait.

*Page* 93, 1885: A herd of 20 wild elephants crossed my path on my road here about 30 miles east of this: 2 fine tuskers, 8 females and 10 young ones. Reported to have killed a man near Kumsi. Traffic along the road was stopped.

*Page* 154, 1890 : I spent two days at the bungalow with my family. It seems unnecessary to add anything to the wealth of eloquence and bathos, not to mention wit, so lavishly squandered in the foregoing pages but it struck me that while the falls (and the patel) have had much attention, the poor bungalow has missed its share. Yet it would repay some small attention, and its occupants would be in a better frame of mind, perhaps, for enjoying the falls. The bungalow has three fine rooms and just the same number of chairs, but one of the latter (inscribed with the name of 'Arry' on both arms) is past use and another will soon follow. The three most important doors have not one bolt between them in working order. The wind rushes in at night with equal fury through broken panes, misfitting doors and dilapidated roof with its natural consequence of headaches and neuralgia. Finally why should all manner of rubbish, wrecks of weather-fencing, straw, paper, old shoes etc. be shovelled over the declivity in front of the bungalow ? The view of the falls from the verandah is very fine and needs no such contrast to set it off. (E. H. Aitken, Asst. Collector of Salt Revenue, 4th January 1890).

*Page* 259, 1 Nov. 1901 : I came here purposely for new specimens of the butterflies and was very successful. Many species here are similar to those found at Kandy, Ceylon. I caught 4 butterflies here that are not to be found at any other place in India, to my knowledge. (H. Cranston).

*17 May, 1954, Monday.*

Very early in the morning was awakened by the Whistling School Boy, which gave a long reveille near our house ; the bird could be heard very distinctly above the noise of the falls. At 6 a.m. the whole river is covered with mist, dense clouds of which come up every few moments from the bottom of the falls. Our bungalow is due north of the falls, the Mysore bungalow is sightly south-west ; the altitude of our rest house by my barometric altimeter is 1,500 ft. above Bombay sea-level. At 7 a.m. just before the sun came out, a large flight of white birds was seen hovering about half way up the falls, many of the birds seem to make their nests on the very steep crags that form the falls.

My own experience of the game of these parts seems to vary very radically from the experience of older visitors. So far in the journey from Hubli to Sirsi and thence to Jog we have only seen a few doves, several hares and a number of monkeys. The Whistling School Boy was heard singing for a long time near our rest house, but has not been heard again.

*First Botanical Outing in Jog.* In order to get an idea of the constitution of the Evergreen Forest near Jog, this morning my party went along the main road ; we tried but could not succeed in penetrating into the forest proper. Climbers with enormous rope-like stems, and very many spiny plants made the attempt at going through the forest out of the beaten tracks a risky and painful process. *Calamus pseudotenuis*, of very painful memories for me, is very abundant and its inflorescence branches are stoutly armed with very nasty recurved thorns. The little *Curcuma* of yesterday was today dug up and showed that the root system possesses fairly long fibrous adventitious roots with a fusiform tuber at the end of each root ; from this character alone the plant seems to be something new. Of the more impressive sights in the forest, one must mention *Lagerstroemia flos-reginae*, gigantic trees covered with masses of large showy flowers ; the tree appears to be wild and indigenous in the district. From the road side we turned to the river ; its bed is nearly covered with a species of *Syzygium* or *Eugenia* shrubs, up to 10 ft. high, in leaf at present. The party moved along the river course until we came to the top of the falls ; from that point of vantage, Rajah is very impressive ; some of our party said their heads were being affected by the sight and had to move away from the brink of the precipice for safety.

Returned home at noon with our collecting boxes filled to overflowing ; the business of identification etc., took us the rest of the day ; the job was only given up at 7 p.m. when darkness forced us to desist from our work. This has been a very successful and interesting day.

*18 May, 1954, Tuesday.*

For the second time, this morning we were awakened by the Whistling School Boy. In the course of these days at Jog, we were often unpleasantly disturbed by a noise as loud and as shrill as that of a knife grinder ; at first I took the noise to be produced by some instrument in the hydro-electric power house ; eventually it was found that the noise was being produced by the many cicadas in the forest ; we found some of those insects and experimented with the noise-making organs, and soon found that the noise at close quarters was almost unbearable.

*Second Botanical Outing.* We went today along the same road as yesterday, but only started collecting plants and photos where we left yesterday. Going along the road to the river ferry, we noticed several species of *Garcinia*, *G. morella*, *G. cambogia* etc., *Pristimera grahamii*, several *Psychotrias* in the undergrowth together with *Ophiorhiza Pavetta* etc. ; in a backwater of the river collected *Lagenandra toxicaria*, very abundant in leaf all over the stream-bed but just out of water.

The river was crossed in a very unsteady canoe ; as I was carrying a number of scientific instruments with me, I did feel rather uncomfortable in the canoe ; the river is said to be about 10 ft. deep at that spot roughly one mile above the falls.

The Mysore side of the river shows even denser vegetation than on the Bombay side ; the forest is over 75 ft. tall ; among the trees we saw a number of unknown species, which had not been seen on the other side. The distance from the ferry to the Mysore bungalow is but one and a half miles, but in this short distance we made a wonderful collection. The sight of the falls from the Mysore bungalow is simply grand ; the four falls are seen in their majestic beauty, there is no obstruction of any sort. While the attendants were preparing some tea, we had time to take some good photos of the sight.

On the return journey we collected seeds of *Ventilago bombaiensis* with the typical twisted wing, saw *Pristimera grahamii*, and one large climbing *Strychnos* which could not be collected from the very high tree on which the plant was mounted. Near the road met several women who were collecting the seeds of *Garcinia morella* ; the rind of the fruit is thrown away, the seeds are used for the extraction of a valuable edible oil that is said to be much esteemed for cakes etc.

The Mysore bungalow is much better kept than the Bombay one ; there is a large park around the bungalow with plenty of room for guests, etc. Electricity is found all over the Mysore side ; and this is why guests can have iced water there from the refrigerators in the bungalow. In every respect the authorities of Mysore have tried to make the place accessible and popular; during our short stay in the bungalow we saw many more people than in several days in the Bombay side.

*19, May 1954, Wednesday.*

From Jog we went along the road to Mavingundi, a village about two miles away. On the way we saw for the first time *Vitex altissima* in flower; some of the trees were loaded with epiphytic orchids in flower and fruit; some of these plants were pressed and some packed in moss for replanting in Bombay. Incidentally such plants were planted in Bombay on our return, but rats and mice seemed to have eaten the lot and spoiled a fine set of specimens. Rice is intensively cultivated in the district, and we were informed that usually two crops are obtained every year. *Areca catechu* is also much cultivated near Mavingundi.

One of the plants we found today was *Parsonsia spiralis*, a plant that later on we tried to collect again for medicinal study; one of our party went in the afternoon to collect materials for study, but returned empty-handed. On being asked why he did not bring the plant, he explained that some ten large monkeys had stood on the road in a very threatening attitude and would not budge from whatever side of the road he tried to pass them; he did not insist, but thought it more prudent to come back to the safety of the house.

*The constitution of the forest at Jog.* Summarising all my observations on the constitution of the forest near Jog, I put down the following notes. The forest in the immediate neighbourhood of Jog is evergreen and very dense; the height goes up to 100 ft., the upper layer seldom going below 75 ft. There are clearly several levels or layers, all connected with numerous climbers. These are the constituents of the various layers:

a. Top layer:
*Hopea wightiana* Wall.
*Syzygium cumini* (Linn.) Skeels.
  (*Eugenia jambolana* Lamk.)
*Pouteria tomentosa* (Roxb.) Baehni.
  (*Sideroxylon tomentosum* Roxb.)
*Holigarna arnottiana* Hook. f.
*Knema attenuata* Warb.
  (*Myristica attenuata* Wall.)
*Artocarpus incisa* Linn. f.
*Lepisanthes tetraphylla* (Vahl) Radlk.
  (*Hemigyrosa canescens* Blume.)
*Garcinia morella* Desr.
*Pithecellobium bigeminum* Mart.
*Garcinia cambogia* Desr.
*Celtis cinnamomea* Lindl.
*Litsea stocksii* Hook. f.
*Lophopetalum wightianum* Arn.
*Ervatamia heyneana* Cooke.
  (*Tabernaemontana heyneana* Wall.)
*Artocarpus hirsuta* Lamk.
*Lagerstroemia speciosa* (Linn.) Pers.
  (*Lagerstroemia flos-reginae* Retz.)

*Macaranga peltata* Muell.
(*Macaranga tomentosa* Wight.)
*Cinnamomum zeylanicum* Blume.
*Caryota urens* Linn.
*Stereospermum personatum* (Hassk.) Chatt.
(*Stereospermum chelonoides* auct., non DC.)
*Aporosa lindleyana* Baill.
*Vitex altissima* Linn. f.
*Terminalia bellirica* Roxb.
*Dysoxylum binectariferum* Hook. f.
*Dillenia pentagyna* Roxb.

b. Second layer, 10–25 ft.
*Allophyllus serratus* (Roxb.) Radlk.
(*Allophyllus cobbe* Hiern.)
*Callicarpa lanata* Linn.
*Trema orientalis* Blume.
*Emblica officinalis* Gaernt.
(*Phyllanthus emblica* Linn.)
*Leea indica* (Burm.) Merr.
(*Leea sambucina* Willd.)
*Mussaenda frondosa* Linn.
*Aporosa lindleyana* Baill.

c. Third layer 3–6 ft.
*Ardisia solanacea* Roxb.
*Melanthesa turbinata* (Koen.) Wight.
(*Breynia patens* Rolfe).
*Psychotria* spec. several.
*Ixora coccinea* Linn.
*Pleomele terniflora* (Roxb.) Merr.
(*Dracaena terniflora* Roxb.)
*Croton gibsonianus* Nim.
*Chasalia curviflora* Thw.
*Solanum* spec.
*Clerodendrum viscosum* Vent.
(*Clerodendrum infortunatum* auct., non Linn.)
*Maesa indica* Wall.

d. Climbers, woody or herbaceous.
*Tylophora indica* (Burm.) Merr.
(*Tylophora asthmatica* W. & A.)
*Ventilago bombaiensis* Dalz.
*Toddalia aculeata* Pers.
*Calamus pseudotenuis* Becc.
*Jasminum rottlerianum* Wall.
*Elaeagnus* spec.
*Cissus discolor* Blume.
(*Vitis discolor* Dalz.)
*Gnetum ula* Brongn.
(*Gnetum scandens* auct., non Roxb.)
*Smilax zeylanica* Linn.
(*Smilax macrophylla* Roxb.

*Zizyphus rugosa* Lamk.
*Pothos scandens* Linn.
*Caesalpinia mimosoides* Lamk.
*Artabotrys zeylanicus* Hook. f. & Thoms.
*Hibiscus furcatus* Willd.
*Gouania microcarpa* DC.
*Rubia cordifolia* Linn.
*Ancistrocladus heyneanus* Wall.
*Raphidophora* spec.
*Schefflera venulosa* Harms.
 (*Heptapleurum venulosum* Seem.)
*Premna coriacea* Clarke.
*Entada phaseoloides* (Linn.) Merr.
 (*Entada scandens* Benth.)
*Cayratia auriculata* (DC.) Gamble.
 (*Vitis auriculata* Wall.)

and many others, though not so common.

The ground is covered with but a few herbs, particularly at the edges of the forest; in dense forest the ground is particularly bare of any vegetation. The more common herbs seen at the edges of the forest are the following:

*Ophiorhiza harrisiana* Heyne.
*Gynura angulosa* DC.
*Hedyotis* spec.
*Leucas aspera* Spreng.

One of the more typical aspects of the forest is that no species may be said to be dominant, perhaps about 15% is the highest percentage of any species. Another feature is the great abundance of climbers, which render the forest almost impenetrable. Thirdly the biotic factor, mainly human, can be seen in many spots; when the forest is cut down by man, it is soon replaced by shrubs or small trees, among which a small species of *Phoenix* is rather common. Finally at the time of our visit the number of mosquitoes and leeches was negligible; within a fortnight of our visit the forest is said to be impassable on account of these pests.

*20 May, 1954, Thursday.*

At 7.30 this morning the bus came to collect us and our luggage from the P.W.D. bungalow, and shortly afterwards left the district. About three miles from Jog we started the climb up the Gersoppa Ghat, a steep but rather gradual climb. There we noticed the devastation that is being brought to the forest by the new electrification schemes; without regard for the forest, an avenue is cut in the forest, 100 ft. on either side of the electric pylons; mighty trees are left lying on the ground until the Forest Department picks them up and puts them up for sale. Some such cuttings we have seen passing through some of the finest spots in the forest, places set aside by the Forest Department for the training of its officers, where every tree has been carefully identified and labelled.

On the return journey to Sirsi, I could notice the condition of the forest, which in many spots has been reduced to scrub forest; after the real forest has been cut down, it is replaced by useless and small shrubs or trees, among which the small *Phoenix*, *Zizyphus* spec. etc. are rather prominent. This is the case particularly in the neighbourhood of villages.

Where the forest has not been disturbed, it reaches a height of 100 ft., with splendid trees of the evergreen type. On the return journey our bus had to stop near the plantations of *Areca catechu* and this gave me a chance to obtain some good photos.

In the middle of the village of Sirsi there is a very large tree (unidentified), one of the mighty giants of the forest, though it is standing alone. The lower part of the trunk is covered with *Pothos scandens*, the upper branches with *Drynaria* ; about 30 ft. from the ground, where the trunk branches, there is a huge cinema poster at the fork, a very incongruous sight on such a beautiful tree.

During our bus journey this morning we had a commotion as some ladies would not come into the bus, and claimed that the men who occupied some front seats had to vacate them ; the reason was that such seats were apparently reserved for the ladies, the seats being marked with a large notice that said ' ONLY LEDEIS '.

*21 May, 1954, Friday.*

During the past night there has been a strong storm, with plenty of noise and fireworks ; at some time in the night there came a downpour of rain ; this caused much commotion among the members of my party, for we had to keep moving from corner to corner so as to escape the many leakages from the roof. In the early hours of the morning it was still raining quietly, but all rain stopped by 7.30 a.m.

*Botanical Excursion to the Kalgar Khan.* This is one of the best evergreen patches near Sirsi ; it is about three miles away from the town. Today we have been lucky in having the help of some local people who accompanied us and did the climbing and seemed to know the local names of most of the plants.

Kalgar Khan gave me the impression that I had been transported to Meroli near Khandala ; the constitution of the forest and the general appearance and even many of the constituent trees were the same in both places. In the undergrowth we saw many seedlings of *Cinnamomum zeylanicum* only 3–8 ft. tall ; *Strychnos nux-vomica* is abundant all over the Khan in fruit ; at the edges of the forest we saw a few plants of *Rauwolfia serpentina* in flower and fruit ; the local people told us that some few years ago the whole place was covered with *Rauwolfia*, but that of late there has been an intense collection, the plant being very highly paid for. The ground inside the Khan is very wet, but there are no leeches as yet. In the Khan we made a search for *Antiaris toxicaria*, which is said to occur here, but in vain ; we saw a gigantic tree, about the largest and tallest in that part of the forest, but even with binoculars we could not discover its identity ; the trunk is unbranched and beautifully straight for over 60 ft. ; the local name is said to be *Halmadi*, which later on I discovered to be *Ailanthus malabarica*.[1]

*The constitution of the forest* at the Kalgar Khan. There are clearly three levels, the uppermost being about 100 ft. high ; as in the evergreen forest at Jog, so here too there was no ground cover, grasses being only found in open spots and near the edges of the forest.

a. The top level or layer.
*Mangifera indica* Linn.
*Beilschmiedia fagifolia* var. *dalzellii* Meisn.

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[1] The correct botanical name of this tree is *A. triphysa* (Dennst.) Alst.

*Hopea wightiana* Wall.
*Strychnos nux-vomica* Linn.
*Dillenia pentagyna* Roxb.
*Cleidion spiciflorum* (Burm.) Merr.
  (*Cleidion javanicum* Blume)
*Knema attenuata* Warb.
  (*Myristica attenuata* Wall.)
*Myristica beddomei* King.
*Terminalia crenulata* Roth.
*Adina cordifolia* Hook.
*Cinnamomum zeylanicum* Blume.

b. The middle layer, 10–25 ft.
*Diospyros microphylla* Bedd.
*Ervatamia heyneana* Cooke.
*Mussaenda frondosa* Linn.
*Macaranga peltata* Muell.
  (*Macaranga tomentosa* Wt.)
*Murraya koenigii* Spreng.
*Vitex altissima* Linn. f.
*Randia brandisii* Gamble.
*Allophyllus serratus* Radlk.
  (*Allophyllus cobbe* Hiern.)
*Emblica officinalis* Gaernt.
  (*Phyllanthus emblica* Linn.)
*Flacourtia montana* Grah.
*Ixora brachiata* Roxb.
'*Strobilanthes*' spec. and many others.

c. Lower level, ground to 3 ft.
*Ophiorhiza harrisiana* Heyne.
*Murraya koenigii* Spreng.
*Chasalia curviflora* Thw.
*Pleomele terniflora* (Roxb.) Merr.
  (*Dracaena terniflora* Roxb.)
*Psychotria*, 2–3 species.

d. Climbers.
*Gnetum ula* Brongn.
  (*Gnetum scandens* auct., non Roxb.)
*Olax* spec.
*Pothos scandens* Linn.
*Luvunga eleutherandra* Dalz.
*Hoya* spec.
*Hemidesmus indicus* R. Br.
*Smilax zeylanica* Linn.
  (*Smilax macrophylla* Roxb.)
*Ancistrocladus heyneanus* Wall.
*Calycopteris floribunda* Lamk.
*Piper* spec.

The three miles return journey was found rather hot and tiring by most of us. Along the main road there is a small herb in flower and fruit, some novelty, that proved to be *Nelsonia campestris*; on the hedges near the road there is plenty of *Santalum album* in flower, none of the plants showing any virus infection so far.

In the evening as we were busy with the morning's collection we were startled by a pitched battle between two camps of monkeys fighting ferociously not far from our house; a well-placed stone put a stop to the proceedings. All through our tour of North Kanara we have been much struck by the numbers and sizes of the monkeys; some of the Forest Rest Houses have been much damaged by the heavy animals jumping on to the roof of the house and breaking numbers of tiles; this was the reason for the leakages in our roof during the past night.

Today several of us have been affected by a nasty irruption in the skin particularly on our faces and hands; there is a continuous itch, which causes us to keep scratching day and night; this type of itch started at Jog, and has kept growing worse all these days; perhaps it is due to the water we have been drinking.

Frogs are singing merrily in our garden in the evening, not a melodious song, but certainly not an unpleasant one, nothing to compare with the Cicadas of Jog; the latter, by the way, have only been heard once since we left Jog.

*May 22, 1954, Saturday.*

Our outing today was to the Hulimane Khan, a small bit of evergreen forest near Oormunde village. The way is all deciduous forest, in parts rather dense, but often very bare, the results of man's interference. Many of the trees showed large masses of orchids, some of them in flower. White ants nests or mounds are rather conspicuous in the deciduous forests; they may be up to 6 ft. tall, and common. Yet the damage of the white ants in the forest seems to be negligible.

On our way to Hulimane Khan our forest guard disappeared for some moments and soon came back with a large bunch of bananas, which we all savoured greatly. Personally I found them about the tastiest bananas I have had. I was informed that the district is famous for the quality of its bananas and mangoes.

Hulimane Khan is a poor type of evergreen forest, much interfered with by cultivators. The undergrowth is almost nil, with about *Caesalpinia mimusoides* and *Clerodendrum viscosum* seedlings as the only shrubby plants. In the forest there are several wild mango trees, the fruit of which proved to be remarkably sweet, though rather fibrous. One of the finds of the day was a large tree of *Hydnocarpus laurifolia* (Denn.) Sleumer (= *H. wightiana* Blume) at the edge of the evergreen near a nulla; the tree was overloaded with fruits, many of which were collected and taken home for medicinal tests.

On our way home on the return journey, we stopped for a cup of tea at a house owned by a Havick Brahmin; he was very kind and nice and offered us some bananas and tea. Our forest guard openly wiped all the tea cups before pouring any tea into them, our host smiling all the while. The belief is that such hosts are very hospitable, but gradually try to poison their guests. The house is low-roofed, thick walled, and very cool inside; its inner walls are decorated with stucco paintings; in the centre of the main room there is a well, where rain water is collected for drinking purposes during the monsoon.

In the evening at about 4 p.m. the sky became black almost suddenly, and we soon had a very violent storm, with plenty of lightning and rain; the temperature came down very considerably after the rain. In open forest today we have seen plenty of *Strychnos nux-vomica*, large trees over 75 ft., with orange fruits about 3-5 inches in diameter; at present no economic use is made of the fruits, except that this is said to be the material used by Havick Brahmins for treating their guests.

*May 23, 1954, Sunday.*

It has not been raining during the night, yet the moisture of the atmosphere is such that everything outside the house is dripping with moisture. In the early morning went to examine Chipgi forest, an interesting patch near Sirsi, but not as good as Kalgar Khan. In this forest we noticed the usual top layer of trees, but there seemed to be no middle layer; the constitution of the forest is as follows:

a. Top layer:
*Terminalia crenulata* Roth.
*Beilschmiedia fagifolia* var. *dalzellii* Miesn.
*Garcinia malabarica* Talb.
*Mangifera indica* Linn.
*Xylia xylocarpa* Roxb.
*Stereospermum personatum* Chatt.
(*Stereospermum chelonoides* auct. non D.C.)
*Litsea* spec.
*Lagerstroemia lanceolata* Wall.
*Dillenia pentagyna* Roxb.
*Terminalia chebula* Retz.
*Strychnos nux-vomica* Linn.

b. Ground layer:
*Randia brandisii* Gamble.
*Garcinia malabarica* Talb.
*Murraya koenigii* Spreng.
*Pavetta* spec.
*Lantana camara* var. *aculeata* Mold. etc.

c. Climbers:
*Gnetum ula* Brongn.
*Premna coriacea* Clarke.
*Toddalia aculeata* Pers.
*Smilax zeylanica* Linn. etc.

Near the edge of the forest there was a large plantation of *Areca catechu*, even more striking than any seen so far. The men collecting the nuts are said to climb one tree at the end of a row of areca trees; after collecting all the nuts from the tree they shake the tree until they come near the next one in the row, then they pass on to the next tree without having to climb down, which would be a very tiring process, on account of the height of the trees. This system of harvesting the nuts explains the presence of numerous epiphytic orchids on the trunks of such trees, which would definitely obstruct the climbers in their efforts.

*24 May, 1954, Monday.*

Another violent storm of rain and lightning in the early morning, and more gymnastics to avoid the rain falling on our beds during the last part of the night. Packed and moved to the bus station on our way to Yellapur.

The Sirsi bus station deserves mention. Sirsi is the centre from which buses go in all directions; the bus station has a time-table posted up, and buses are sent out by the ringing of a large bell, everything very well organised. Whilst waiting for our bus, which was over two hours late, we were invaded by a host of beggars, who proved to be very persistent.

The journey from Sirsi to Yellapur is most interesting botanically; the road goes through some evergreen forests for the greater part of the way; the road is lined with gigantic trees, many of which are covered with climbers. The last three or four miles before Yellapur are particularly interesting botanically, on account of the very dense forest on either side of the road. Today we noticed a large fox standing in the middle of the road at the approach of our bus, and only moved away when we were but about twenty yards from the spot; the fox then moved into the forest and watched our bus as it passed but ten yeards away. A little later along the side of the road I noticed a large brownish snake, probably a *Dhaman*, gliding leisurely into the forest. These two animals are about the limit of our zoological observations in the district; we looked for animals, but found very few indeed.

The arrival of our large party at the Yellapur bus station caused a commotion; we were received by the forest guard in full uniform, who was at once nicknamed 'Major-General' Adam Sheik Mahmud; the forest bungalow is just in front of the bus station. Through the kind offices of Mr. Bhathena, the Forest Utilisation Officer, and of Dr. Patil the Forest Botanist, we found that everything had been got ready for us in the bungalow; the Asst. Divisional Forest Officer, Mr. P. K. Vasuvada, made our stay in Yellapur most comfortable and pleasant, as well as profitable. The Yellapur Forest Bungalow is one of the finest so far encountered in this trip; the building is solid and very clean; outside there is a fine garden with nice clean lawns and plenty of flowers. Monkeys seem to like this bungalow in a particular manner; as we sat in the verandah discussing plans, a large host of monkeys amused themselves playing and fighting on the lawns of the house.

Our first outing of Yellapur was late in the evening, when Mr. Vasuvada took us to some dense forest but half a mile away from the village. Among other interesting items, today we collected *Rhynchostylis retusa* in full bloom, *Hoya retusa*, etc.

*25 May, 1954, Tuesday.*

The night has been quiet and restful except for the armies of very hungry mosquitoes that seemed to have been waiting for our arrival to have a proper meal.

At 7.30 a.m. we were taken by lorry to the *Linear Tree Increment Plot* (LTI in short), the Telgiri Khan. Along the road the forest is impressive, large and massive trees line the road, and as we get nearer to the LTI the forest becomes denser.

The LTI plot is a narrow band of forest in the middle of the evergreen, about 50 yards broad, and nearly half a mile long; the undergrowth has been cleared to some extent, and all the trees and large shurbs have been identified and labelled. The identification of such trees has been a laborious task that has taken years to accomplish; the trees are over 75 ft. tall, their upper branches all interlinked together. All the trees in the LTI plot are indigenous, that is to say, no tree has been especially planted by the Forest Department. The aim of such plots is to give Forest Officers the chance of learning the various constitutents of their forests in a small compressed space. We spent over three hours moving in the evergreen forest, and noting the trees as well as the undergrowth. The following is the result of our examination:

a. Top level, trees 75 ft. and over in height.
*Tetrameles nudiflora* R. Br.
*Polyalthia cerasoides* Benth. & Hook. f.
*Cinnamomum zeylanicum* Blume.
*Macaranga peltata* Muell.
*Terminalia crenulata* Roth.
*Terminalia bellirica* Roxb.
*Caryota urens* Linn.
*Pterygota alata* (Roxb.) R. Br.
(*Sterculia alata* Roxb.)
*Dysoxylum malabaricum* Bedd.
*Knema attenuata* Warb.
*Myristica* spec. (*beddomei?*)
*Aporosa lindleyana* Baill.
*Terminalia arjuna* W. & A.
*Diospyros microphylla* Bedd. etc.

b. Middle layer:
*Leea indica* (Burm.) Merr.
*Ardisia solanacea* Roxb.
*Allophyllus serratus* Radlk.
*Murraya koenigii* Spreng.
*Emblica officinalis* Gaernt.
*Cordia macleodii* Hook. f.
*Randia brandisii* Gamble.

c. Ground level, 4–36 inches.
*Chasalia curviflora* Thw.
*Rauwolfia serpentina* Benth.
*Nervilia infundibulifolia* Bl. & McC.
*Curculigo orchioides* Gaernt.
*Elephantopus scaber* Linn.
*Psychotria* spec.

d. Climbers: the usual ones in these parts, particularly great masses of *Gnetum ula* Brongn.

This Khan is a mixture of evergreen and deciduous trees, the former predominating, though no species can be said to be dominant.

In the course of the evening while writing up my diary, my attention was called to some very loud barking of dogs and 'swearing' of monkeys; several monkeys had been treed on an isolated tree, and the dogs were mounting guard at the foot of the tree; every now and then, when a monkey tried to come down, the dogs barked furiously. For as long as the watch of the dogs lasted, they had the best in the fight; however, the dogs' attention was distracted for just a few moments, and then all the monkeys came down and ran into one of the trees at the edge of the forest; it was noticed that mother monkeys with their babies hanging from their chests were the loudest in ' swearing ' at the dogs.

We have been looking for some specially good trees and in vain; we have searched for *Ailanthus malabarica*, *Antiaris toxicaria*, etc., but without success, we had not recognised the *Halmadi* tree as *Ailanthus*. Today one of our party went to Karwar in search of *Samādera*, which is said to be common in those parts; three days spent in the search, with the help of some of the local Vaidyas, did not succeed in finding the tree.

*26 May, 1954, Wednesday.*

In the early morning went to Sahasrahalli Khan, not more than a mile from our residence. Along the main road we found numerous specimens of *Rauwolfia densilfora*, shrubs 6–10 ft. high, with plenty of flowers or fruits. *R. serpentina* was seen only on sloping ground near the Khan, in ground from which the forest had been cut a few years ago.

The forest at Sahasrahalli Khan is imposing; most of the trees are straight, unbranched for over 50 ft., and then going up to 100 ft. or more. There are mighty climbers going over such trees, among which *Gnetum ula* is probably the mightiest.

The constitution of the forest is approximately as follows;

a. Top layer, up to 100 ft. or more.
*Mallotus albus* Muell.-Arg.
*Lophopetalum wightianum* Arn.
*Lagerstroemia lanceolata* Wall.
*Ervatamia heyneana* Cooke.
*Syzygium cumini* (Linn.) Skeels.
*Holigarna arnottiana* Hook. f.
*Vitex altissima* Linn. f.
*Knema attenuata* Warb.
*Diospyros montana* Roxb.?
*Artocarpus hirsuta* Lamk.
*Garcinia xanthochymus* Hook. f.
*Careya arborea* Roxb.
*Strychnos nux-vomica* Linn.
*Terminalia chebula* Retz.
*Terminalia crenulata* Roth.
*Xylia xylocarpa* Roxb.
*Machilus macrantha* Nees.
*Chukrassia tabularis* Juss. var.?
*Beilschmiedia fagifolia* var. *dalzellii* Meisn. etc.

b. Middle layer:
*Solanum giganteum* Jacq.
*Allophyllus serratus* Radlk.
*Ardisia solanacea* Roxb.
*Mussaenda frondosa* Linn.
*Pajanelia multijuga* DC.
*Leea indica* Merr.

*Murraya koenigii* Spreng.
*Strychnos nux-vomica* Linn. seedlings.

c. Ground vegetation, less than 3 ft. tall.
*Curcuma* spec.
*Centella asiatica* Urb.
*Cissus discolor* Blume.
*Nervilia infundibuliformis* Bl. & McC.
*Murdannia scapiflorum* Royle.
*Hypoxis aurea* Lour.
*Ophiorhiza harrisiana* Heyne.

d. Climbers the usual ones, with plenty of *Radermachera* spec.

*27 May, 1954, Thursday.*

Packing in early morning in readiness to move to Halyal according to programme. The road to Halyal is fairly good, but the bus either had no spring or was unduly overloaded, so that along the road we got every jolt in our bones. Up to about half way to Halyal the forest is mixed evergreen and deciduous, then the deciduous trees seem to become dominant, until in the neighbourhood of Halyal it is clearly a deciduous forest, whatever is left of it, which is not much. Near Halyal cultivation is intense. Along the road sides on various trees I noticed the largest masses of *Acampe premorsa* that I have seen in Western India.

The forest bungalow at Halyal is situated inside the Fort, a large structure built of loose stones without cement; in several spots the walls are crumbling down, and in this they are substantially helped by several *Ficus* that send their roots into the cracks in the walls. Monkeys are also in evidence here, for every now and then we heard loud noises over our heads, caused by monkeys disporting themselves on the roof of the house.

In the afternoon went to see the Research Experimental Station of the Forest Department; the various experiments being conducted in the station are beautifully described in the report of the Silviculturist for 1951. Many interesting trees from other parts of India or from abroad are under trial, and some have given very good results. *Rauwolfia serpentina* was under cultivation; vegetative reproduction gave good results, seeds did not do well, as seldom more than 10% did germinate. Of the imported trees that seemed to be doing best, *Eucalyptus citriodora* and *Duabanga grandiflora* Walp. seemed to be conspicuous; trees planted but four or five years ago were already over 30 ft. high and going strong.

*28 May, 1954, Friday.*

In the morning went out to the village, to photograph several trees loaded with Flying Foxes; two or three of the largest trees were just black with these strange animals, who kept a loud and constant noise going through the hours of daylight.

After lunch we packed ourselves into a taxi and moved to Dandeli; the packing was tight, there were four of my party, the driver and two assistant drivers. The taxi, an old crock, kept rattling as if it could not go one yard further; as the road in the main is downwards from Halyal to Dandeli, our driver shut off the engine most of the time, and just kept going by gravity. The forest along the road becomes soon very dense, even though the deciduous character is quite clear ; teak is abundant, and where teak has been cut down and not replanted, bamboos cover much of the ground. The journey by taxi took only 40 minutes. In Dandeli we were accommodated in the ' Riverview ' forest bungalow, a palatial building with a grand stand view of the National Animal Sanctuary across the Kali Nadi just in front of the bungalow.

*29 May, 1954, Saturday.*

In the morning we were told that there are crocodiles in the river, which apparently no one has ever seen, at least I could not discover any of the local inhabitants who had seen them ; it is a fact, however, that people do not go swimming in the river. In the night I heard some violent splashes in the river, but in spite of a good moon could not see anything in the river.

*Riverside botanical outing.* Our first outing at Dandeli has been along the river banks and on rocks in the river bed. Found some of the familiar plants, and a multitude of novelties, among them *Drosera burmannii*, *Terminalia arjuna*, etc. Along the banks there are plenty of mango trees, the fruit lying on the floor or in the water; no one seems to care for such fruit, *Terminalia arjuna* is plentiful along the sides of the river, tall straight trees, with whitish trunks. Some of our party have been searching all these days for *Cryptocorine*, which we found in abundance in the river bed in or just out of water.

Today several of us seemed to come under the weather and this we attributed to the water ; our servants just took water from the river and served at table untreated. We started on Entero-vioform treatment, and our troubles stopped at once.

*30 May, 1954, Sunday.*

The animal sanctuary is just across the river ; all we saw were crowds of monkeys, some domesticated buffaloes and heard junglefowl and an occasional woodpecker. The present area of the animal sanctuary is about 70 sq. miles ; there are said to be some interesting animals still left, such as sambar, an occasional bison etc. There are several villages in the territory of the sanctuary, and these are supposed to be moved out of the place to prevent the wholesale poaching that goes on under the name of crop protection ; so far, however, no village has been moved.

*Botanical excursion to the Moist Deciduous Forest.* The spot chosen for exploration was the forest along the right-hand side of the Experimental Station not far from the forest bungalow. The more striking points of today's exploration are these : 1. *Curcuma* is very abundant all over in the undergrowth, often in leaf. 2. Mosquitoes are there in millions and very hungry. 3. The constitution of the forest is rather uniform, much bamboo and plenty of *Tectona*, the two dominant plants ; in the undergrowth found plenty of *Eranthemum roseum*, *Murdannia scapiflorum* etc. On our return home we identified the plant *Eranthemum roseum*, and decided to collect some more for chemical and medicinal trials. Two parties went out to collect the plants ; both parties returned in about half an hour for diverse reasons. One party said they could not go any further on account of the mosquitoes ; the second party saw in the ground the clear marks where a tiger had just sharpened its claws, and from the size of the marks, it was a large animal. The forest guards informed us that all through the previous season two large tigers have been living in that part of the forest. On the way home some of them saw a hare of gigantic size, 'almost like a small deer'.

In today's excursion I gathered some interesting plants, that gave many of us great pleasure; *Eranthemum roseum* for medicinal trials, very abundant in the undergrowth; *Phaulopsis dorsiflora* Santapau, the first time I see this plant in the field; *Justicia trinervia*, *Nelsonia campestris*, etc. Among the more abundant plants in the undergrowth is *Murdannia scapiflorum* which is supposed to be a very rare plant in Bombay State.

*31 May, 1954, Monday.*

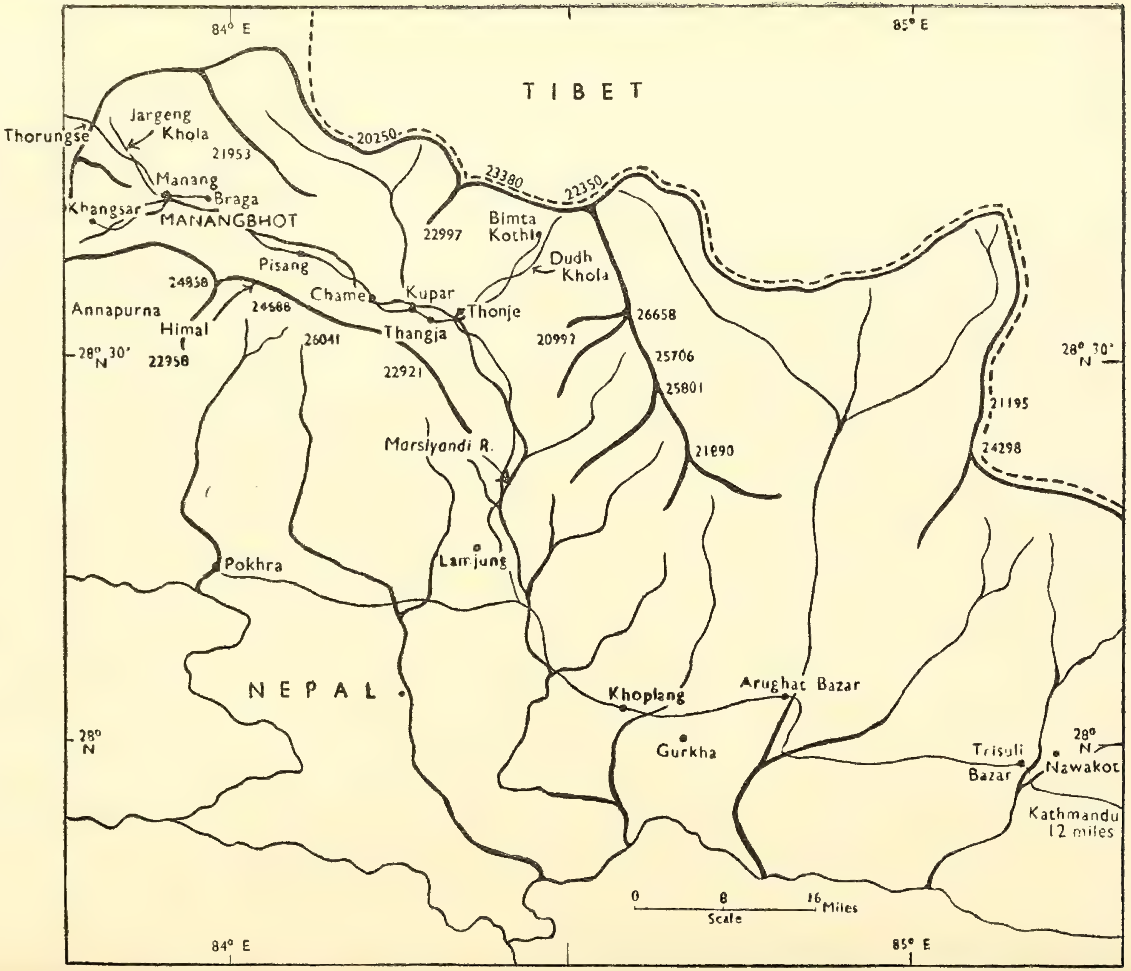
In a private car and a forest lorry went to Shoroli, about 8 miles south of Dandeli. At the office of the Industrial Mining Enterprises, Shiroli Mines, we were shown samples of the manganese ore that is being extracted there. The mines are all surface operated; the upper ground layers are of bright reddish or yellowish laterite; below there are streaks or veins of manganese ore, at times mixed with iron ore; the latter is not extracted, the former is only extracted when it contains over 50 % manganese.

*Shiroli Khan.* This is an impressive plot of evergreen forest; the trees there reach gigantic proportions; climbers are all over the place, epiphytes are quite as common. It is not possible to separate the forest into several layers, for the various layers seem to mix together into a very dense mass. The ground slopes very steeply, and this adds to the difficulty of separating the various layers of the forest. The more noticeable plants of the Khan are the following:

*Pothos scandens* Linn.
*Piper subpeltatum* Willd.
*Mallotus stenanthus* Muell.
*Harpullia arborea* Radlk.
  (*Harpullia imbricata* Thw.)
*Ardisia solanacea* Roxb.
*Capparis heyneana* Wall.
*Gnetum ula* Brongn. an immense climber.
*Pristimera indica* (Willd.) A. C. Smith.
  (*Hippocratea indica* Willd.)
*Tetrameles nudiflora* R. Br.
*Callicarpa lanata* Linn., a tree.
*Holigarna grahamii* Hook. f.
*Solanum ferox* Linn.
*Radermachera* spec.
*Barleria courtallica* Nees.
*Sarcochilus* spec.
*Solanum verbascifolium* Linn.
*Pouteria tomentosa* Baehni.
*Ancistrocladus heyneanus* Wall.
*Alstonia scholaris* R. Br., a gigantic tree.
*Elatostema lineolatum* Wt.
*Mallotus albus* Muell.
*Naravellia zeylanica* DC. etc.

This was the last outing of this trip and it was a fitting conclusion to a most interesting field excursion. Everywhere we received the greatest kindness from the Forest Department, Bombay State; in Dandeli

Mr. Rajput, the Mining Engineer of the Industrial Mining Enterprises, gave us much help during our short stay in the district ; to them all go our gratitude and acknowledgements. Dr. F. A. Kincl deserves special mention for it was to accompany him in his collection of medicinal plants that I was given the grand opportunity of touring through North Kanara. Dr. R. P. Patil, the Forest Botanist, Bombay State, made all the arrangements in connection with the reservation of bungalows, etc. ; without his help we would have been seriously handicapped in our tour.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Marsiyandi R.
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Lamjung
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Gurkha
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Nawakot
Kathmandu
12 miles
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Scale

Sketch Map of NW. Nepal

# SOME BIRDS FROM NORTH-WESTERN NEPAL

BY

COL. D. G. LOWNDES

(*With a sketch map*)

The birds included in the following list were collected for the British Museum by Major J. O. M. Roberts, M.C., 1/2nd K.E.O. Goorkha Rifles, during a mountaineering expedition to Central Nepal led by Major H. W. Tilman, D.S.O., M.C., in the summer of 1950. The species marked with an asterisk were observed by me but not collected.

But for the fact that the firearms available were far from satisfactory and that the bulk of the cartridges provided were unfortunately loaded with No. 6 shot, the collection would have been more extensive.

The localities Manangbhot, Jargeng Khola, Khangsar and Pisang (see sketch map) are in the dry zone of the upper valley of the Marsiyandi River which is effectively sheltered from the monsoon by the Annapurna Range which rises to a height of over 26,000 ft.

The Manangbhot area is separated from Langtang Khola where Mr. Polunin collected in 1949 (see *JBNHS*, 52 : 887) by about 100 miles. The terrain here is of a more arid ' Tibetan ' character, and markedly different from the Rasua Garhi Dist. of Central Nepal. We are greatly indebted to Sir Norman Kinnear for the determination of the specimens. His notes appear in square brackets). @ indicates that the bird was not recorded by Polunin.

## LIST

@ **Corvus corax :** The Raven.*

Ravens were frequently seen in the valley of the Jargeng Khola, between 14,000 and 15,000 ft. during July and August.

**Urocissa erythroryncha occipitalis :** Redbilled Blue Magpie.

♂ 31-9-50 Khamihoke 3,000 ft.
In open forest.

**Urocissa f. flavirostris :** Yellowbilled Blue Magpie.

♂ 30-9-50 Khoplang 3,000 ft.
In open forest.

@ **Dendrocitta formosae himalayensis :** Himalayan Tree Pie.

♂ 29-9-50Khoplang 3,000 ft.
In open forest.

**Nucifraga caryocatactes hemispila :** Himalayan Nutcracker.

♂♀ 6-7-50 Manangbhot 12,000 ft.
Frequent in pine forest.

@ **Pyrrhocorax pyrrhocorax himalayensis :** Redbilled Chough.

♂ 9-7-50 Manangbhot 12,000 ft.
Common up to 16,000 ft.

**Pyrrhocorax graculus :** Yellowbilled Chough.

♂ 10-7-50 Manangbhot 12,000 ft.
Common up to 16,000 ft. Often in company with the former.

**Parus monticolus monticolus :** Greenbacked Tit.

♀ 16-8-50 Chame 8,000 ft. ; ♂ 21-8-50 Thonje 6,500 ft.

One of the commonest tits in the wet zone from 6-12,000 ft. [12,000 ft. is the previously reported limit—N.B.K.]

**Parus rubidiventris :** Rufousbellied Tit.

♀♂♀♂ 26-6-50 to 24-7-50 Manangbhot 12,000 ft.

From 8,000–13,000 ft. among conifers and birch. The 'highest' tit and common between 11 and 12,000 ft. [Interesting that this was the commonest tit between 11 and 12,000 ft.—N.B K.]

**Parus ater aemodius :** Himalayan Cole Tit.

♂ 17-8-50 Thangja 8,000 ft. Among conifers with other tits and warblers ; ♂ 24-8-50 Bimta Kothi 12,000 ft. In pine trees near the glacier. [The specimens are probably the most westerly that have been obtained. —N.B.K.]

**Parus d. dichrous :** Brown Crested Tit.

♂ 6-9-50 Bimta Kothi 10,000 ft. In dense forest.

@ **Trochalopteron erythrocephalum :** Redheaded Laughing Thrush.

♂ 18-8-50 Thangja 8,000 ft.
In dense mixed forest.

**Trochalopteron a. affine :** Blackfaced Laughing Thrush.

♀ 13-8-50 Chame 9,000 ft.
In pine and birch thickets. Also seen at 12,000 ft. at Bimta Kothi.

**Trochalopteron lineatum setifer :** Streaked Laughing Thrush.

♂ 18-9-50 Thonje 6,500 ft. In mixed forest and scrub.

[Ticehurst, Whistler and I consider that the bird figured by Gould in 'A Century of Birds from the Himalayas' is the western and NOT the Nepal bird. Hodgson named the Nepal bird *setifer* and we consider it should stand as *T. lineatum setifer*, *T. l. lineatum* being the bird from the Simla—Kumaon area. (see *JBNHS*, 52 :—April 1955)—N.B.K.]

**Trochalopteron v. variegatum :** Variegated Laughing Thrush.

♂♀ 6-7-50 Manangbhot 12,000 ft.

Among conifers and birches, from 9,000 to the tree line, 13,000 ft. The 'highest' and commonest laughing thrush.

[I do not think it has been recorded as high as 13,000 ft. before—N.B.K.]

@ **Fulvetta v. vinipecta :** Hodgson's Fulvetta.
♂ 15-8-50 Chame 8,000 ft.
Among pines and birches ; feeding in company with warblers.

**Leioptila c. capistrata :** Blackheaded Sibia.
♂ 18-8-50 Thangja 8,000 ft.
Common from 6,500 to 10,500 ft. in the wet zone.

**Siva s. strigula :** Stripethroated Siva.
♂ 17-8-50 Thangja 8,000 ft.
One or two seen in pines and mixed forest between 8,000 and 10,000 ft.

**Ixulus f. flavicollis :** Yellownaped Ixulus.
♂ 22-8-50 Thonje 6,500 ft.
Among bushes and willow trees.

**Yuhina g. gularis** : Stripethroated Yuhina.
♀ 18-8-50 Thangja 8,000 ft.
In company with Stripethroated Sivas.

**Yuhina occipitalis :** Slatyheaded Yuhina.
♂ 17-8-50 Chame 8,000 ft.
Noisy family parties in forest and scrub.

**Certhia familiaris mandellii :** Nepal Tree Creeper.
♀ 14-7-50 Manangbhot 13,000 ft.
A few seen among conifers between 11,000 and 13,500 ft.

**Troglodytes troglodytes nipalensis :** Nepal Wren.
♀ 29-8-50 Bimta Kothi 11,000 ft.
On open stony ground.

**Hodgsonius ph. phoenicuroides :** Hodgson's Shortwing.
♂♀ 2-7-50 Jargeng Khola 14,000 ft. ; ♂ 7-7-50 Manangbhot 13,000 ft. ♀♂♀ 24-7--50 and 3-8-50 Khangsar 13,500 ft.
In birch thickets and juniper etc. scrub from 10,000 to 14,500 ft. Common. An isolated pair seen at 8,000 ft.

@ **Rhodophila f. ferrea :** Darkgrey Bush Chat.
♂♂ 21-9-50 Thonje 6,500 ft.
In mixed forest and scrub.

**Phoenicurus frontalis :** Bluefronted Redstart.
♂ 6-7-50 Jargeng Khola 15,000 ft. ; ♂ 18-7-50, Manangbhot 12,500 ft.
Males fairly common in pines and birches and open ground. 11,500 to 15,000 ft. Few females seen.

**Phoenicurus ochrurus rufiventris :** Indian Black Redstart.
♂♂ 29-8-50 Bimta Kothi 12,000 ft. Open stony ground.

@ **Phoenicurus schisticeps :** Whitethroated Redstart.

♂♂♀♂♂♀ 28-6-50 to 29-7-50 Manangbhot 12,000 ft. ; ♀♂ 24-7-50 and 30-7-50 Khangsar 13,000 ft.

Common among conifers and in juniper scrub 10,000 to 13,000 ft.

**Chaimorrhornis leucocephala :** Whitecapped Redstart.

♀ 20-7-50 Manangbhot 12,500 ft. ; ♂ 29-7-50 Khangsar 14,000 ft.

Range 6–15,000 ft., but very scattered above 11,000 ft.

**Rhyacornis f. fuliginosa :** Plumbeous Redstart.

♂ 16-8-50 Chame 8,000 ft.

Up to 10,500 ft. in the wet zone only. More common than the former at the lower levels.

**Ianthia cyanura rufilata :** Redflanked Bush Robin.

♀ 11-7-50, Manangbhot 13,000 ft.; ♀ 15-7-50 Manangbhot 12,500 ft.; ♀ 18-7-50 Manangbhot 12,000 ft.

Fairly plentiful locally in the pine and birch forest between 10 and 13,000 ft., but very few males seen and none secured.

@ **Calliope p. pectoralis :** Himalayan Rubythroat.

♂♂ 2-7-50 and 6-7-50 Jargeng Khola 14 and 15,000 ft.; ♀♂ 5-8-50 Khangsar 14 and 15,000 ft.

Fairly common in dwarf juniper and on open hill sides from 13–5,000 ft.

@ **Monticola solitaria pandoo :** Indian Blue Rock Thrush.

♀♂ 26-6-50 and 2-8-50 Manangbhot 12,000 ft.

Rare. The only pair seen, on rocky cliffs.

**Myophoneus caeruleus temminckii :** Himalayan Whistling Thrush.

♀ 14-8-50 Chame 8,500 ft.

Also seen at 12,000 ft. in Manangbhot, but scarce above 8,500 ft.

@ **Accentor collaris nipalensis :** Alpine Accentor.

♀♂♂ 29-7-50 and 7-8-50 Khangsar 15,500 ft.

Among boulders on rocky slopes and screes from 15–16,000 ft.

**Prunella s. strophiata :** Rufousbreasted Accentor.

♂♂♀ 2-7-50, 5-7-50 and 30-7-50 Jargeng Khola 14,000 ft.

Very common in juniper scrub 13,000–15,000 ft.

**Muscicapa s. strophiata :** Orangegorgeted Flycatcher.

♂ 14-8-50 Chame 8,560 ft.

At the edge of the forest. Also seen at 12,000 ft. at Bimta Kothi.

@ **Muscicapa sibirica fuliginosa :** Sooty Flycatcher.

♂ (imm.) 17-8-50 Thangja 8,000 ft.

Singly in clearings in the forest.

@ **Eumyias thalassina :** Verditer Flycatcher

♀ 22-8-50 Thonje 6,500 ft.

A few seen among willows and bushes.

@ **Culicapa c. ceylonensis**: Greyheaded Flycatcher.

♂ 20-9-50 Thonje 6,500 ft.

In mixed forest and scrub.

@ **Alseonax ruficaudus**: Rufoustailed Flycatcher.

♂ 19-7-50 Manangbhot 12,000 ft.

Only two seen among pines and birches.

@ **Cyornis magnirostris**:

♂ (imm.) 20-8-50, Thangja 8,500 ft.

In dense forest.

**Lanius schach nipalensis**: Rufousbacked Shrike.

♂♀ 26-8-50 Manangbhot 12,000 ft.

Among bushes and in fields. 8–13,000 ft. Common from 11–12,000 ft., but not seen between 9,000 and 14,000 ft.

@ **Pericrocotus ethologus laetus**: Shortbilled Minivet.

♂♀ 4-7-50 Manangbhot 12,000 ft.; ♀ (imm.) 3-8-50 Khangsar 13,000 ft.

Among conifers 12–13,000 ft. In small parties; occasionally seen.

@ **Phylloscopus affinis**: Tickell's Willow-Warbler.

♀♂♂ 28-6-50, 1-7-50 and 6-8-50 Manangbhot 12,000 ft.; ♀ 8-8-50 Khangsar 13,000 ft.

Common among pines and in juniper scrub from 12–14,000 ft. The 'highest' warbler.

**Phylloscopus proregulus chloronotus**: Pallas's Willow-Warbler.

♂ 28-6-50 Manangbhot 12,000 ft.

Among pine and birch. One only.

**Phylloscopus r. reguloides**: Blyth's Crowned Willow-Warbler.

♂ 15-8-50 Chame 8,000 ft.; ♂ 20-8-50 Thangja 8,000 ft.; ♂ 12-9-50., Thonje 6,500 ft.

In pine and birch thickets, etc.

@ **Phylloscopus t. trochiloides**: Greenish Willow-Warbler.

10-7-50 Manangbhot 12,000 ft.; ♂ 17-8-50 Chame 8,000 ft.

In coniferous and mixed forest, 10–13,000 ft. Overlaps the range of *P. affinis*, but does not occur so high.

**Seicercus b. burkii**: Blackbrowed Flycatcher-Warbler.

♂ 13-8-50 Chame 9,000 ft.; ♂ 23-8-50 Bimta Kothi 10,000 ft.

In thickets between 9,000 and 10,000 ft.

**Perissospiza affinis**: Allied Grosbeak.

♂ 3-8-50 Manangbhot 12,500 ft.

In pines. One only.

**Perissospiza c. carnipes** : Whitewinged Grosbeak.

♂♂ 3-7-50 and 5-7-50 Jargeng Khola 14,000 ft.; ♂♂ 2-7-50 and 4-7-50 Manangbhot 12,500 ft.

In pines and juniper trees 10-14,000 ft.; common between 12,000 and 13,000 ft.

**Pyrrhula erythrocephala** : Redheaded Bullfinch.

♀♂♀♂♀ 2-7-50 to 8-8-50 Manangbhot 12–13,000 ft.

In mixed forest. Not common.

**Carpodacus p. pulcherrimus** : Beautiful Rosefinch.

♂♀♀ 1-7-50 to 5-7-50 Jargeng Khola 13–14,000 ft.; ♂ 13-7-50, Manangbhot 12,000 ft.; ♂♀ 24-7-50 and 28-7-50 Khangsar 13,000 ft.

13–15,000 ft. Occurs at higher levels than *C. erythrinus roseatus*, but seen together at 13,000 ft.

**Carpodacus erythrinus roseatus** : Common Rosefinch.

♂♀♂♂♀♀ 26-6-50 to 15-7-50 Manangbhot 12,000 ft.; ♂ 24-7-50 Khangsar 13,000 ft.

9–14,000 ft. Fairly common upto 13,000 ft. among rocks and scrub Sometimes in open coniferous forest.

@ **Pyrrhospiza punicea** : Redbreasted Rosefinch.

♂♂ 5-7-50 and 7-7-50 Jargeng Khola 14–14,500 ft.

Seen on five occasions only, among rocks and juniper scrub. Only one female seen.

@ **Carduelis caniceps** : Himalayan Goldfinch.

♂♀ 28-6-50 Manangbhot 12,000 ft.; ♂ 29-7-50 Khangsar 13,000 ft.

In fields and scrub, 10–13,000 ft. Quite large flocks in June.

**Hypacanthis s. spinoides** : Himalayan Greenfinch.

♂♀♂ 28-6-50 to 15-7-50 Manangbhot 12,000 ft.

Common in flocks, 8–12,500 ft. in fields and forest. In mid-July 10–11,000 ft.

**Fringillauda n. nemoricola** : Hodgson's Mountain Finch.

♀ 29-7-50 Khangsar 15,500 ft.; ♂ 4-7-50 Jareng Khola 14,000 ft.

In dwarf juniper 14–15,500 ft. and higher. In pairs and large flocks.

**Passer montanus malaccensis** : Tree Sparrow.

♀ 11-7-50 Manangbhot 12,000 ft.

Common in villages and fields upto 13,000 ft.

@ **Emberiza cia stracheyi** : Eastern Meadow Bunting.

♂♂♂♀♂ 24-6-50 to 30-7-50 Manangbhot 12–13,000 ft.

10,000—13,000 ft.

@ **Motacilla cinerea melanope** : Grey Wagtail.

♂ 12-8-50 Pisang 10,000 ft.; ♂ 21-8-50 Thangja 7,000 ft.; ♂♂ 31-8-50 Bimta Kothi 12,000 ft.

Open wet ground and under bushes. Not above 10,000 ft. in the dry zone, but up to 13,500 ft. in the wet zone. Feeding young at Pisang on 29-5-50.

@ **Motacilla alba alboides** : Hodgson's Pied Wagtail.

♂♂ 26-6-50 and 28-6-50 Manangbhot 12,000 ft.
Wet fields and stony stream beds. Not common.

@ **Motacilla alba personata** : Masked Wagtail.

♂♂ 15-7-50 Manangbhot 11,500 ft.
One only seen on open stony ground.

@ **Anthus hodgsoni** : Indian Tree Pipit.

♂ 2-7-50 Jargeng Khola 15,000 ft.; ♀ 2-7-50 Manangbhot 12,500 ft.; ♂ 30-7-50, o ? 6-8-50 Khangsar 13,000 ft.; ♂ 20-8-50 Thangja 8,000 ft.

Seen on open rocky ground. In forest and also among dwarf juniper up to 14,500 ft. at the edge of forest.

**Anthus roseatus** : Hodgson's Pipit.

o ? 6-8-50 Khangsar 14,500 ft.
Locally fairly common on open slopes to 15,500 ft.

@ **Otocoris alpestris elwesi** : Elwes's Horned Lark.

♂ 5-8-50 Khangsar 15,000 ft.
One pair only seen with young on high open slopes.

**Aethopyga n. nipalensis** : Nepal Yellowbacked Sunbird.

♂♀♂ 12-9-50 to 21-9-50 Thonje 6,500 ft.; ♂ 15-8-50 Chame 8,000 ft.
In forest and open scrub. Among pine trees.

@ **Pachyglossa melanoxantha** : Yellowbellied Flowerpecker.

♂ 18-8-50 Thonje 8,000 ft.
In clearings in dense forest. Seen nowhere else.

**Picus s. squamatus** : Scalybellied Green Woodpecker.

♀ 23-8-50 Bimta Kothi 9,500 ft.; ♂ 10-9-50, Thonje 6,500 ft.
A single bird seen at the edge of mixed forest.

@ **Dryobates macei** : Fulvousbreasted Pied Woodpecker.

♀ 17-8-50 Thangja 8,000 ft.
In mixed forest.

**Cuculus canorus** : Cuckoo.*

Cuckoos were comparatively plentiful (and were breeding) between 12,000 and 13,500 ft. in Manangbhot from June to August.

**Rhopodytes tristis** : Greenbilled Malkoha.

♀ 30-9-50 Khamihoke 2,000 ft.
In open forest.

@ **Coracias b. benghalensis** : Indian Roller.

♂ 5-8-50 Manangbhot 12,000 ft. A single stray bird in open meadow. [Occurrence at 12,000 ft. is remarkable, as it is not usually found above 4,000 ft.—N.B.K.]

**Upupa epops** : Hoopoe.*

Hoopoes appeared in Manangbhot in small numbers during July and were in evidence until the second week of August.

@ **Strix nivicola** : Himalayan Wood Owl.

♀ 14-8-50 Chame 9,000 ft.

Pine forest. Almost the only owl seen in five months.

@ **Gyps himalayensis** : Griffon Vulture.*

A single pair of Griffon Vultures was frequently to be seen in the area round Braga village, 11,500 ft., during June and July.

@ **Gypaëtus barbatus** : Lämmergeier.*

Several pairs of Lämmergeiers were present in Manangbhot from May to September at altitudes from 11,000 to 14,000 ft.

**Milvus govinda** : Pariah Kite.*

A single pair of Kites was present in the area of Braga village during July.

Eagles were frequently to be seen soaring above the Marsiandi Valley in Manangbhot during June and July ; possibly *Aquila chrysaëtos.*

Smaller birds of prey were conspicuous by their absence, but on 27 July a Falcon took a young—very young—Snowcock from a family party that Major Roberts was stalking.

@ **Sphenocercus s. sphenurus** : Wedgetailed Green Pigeon.

♀ 18-8-50 Thangja 8,000 ft.

Fairly common in the tree-tops in mixed forest, and flighting.

@ **Columba livia** : Rock Pigeon.

♂ (imm.) 3-7-50 Manangbhot 12,000 ft.

Common 10–13,000 ft. on fields, cliffs and gorges. Small flocks, often in company with *leuconota.*

**Columba l. leuconota** : Snow Pigeon.

♀ 28-6-50 Manangbhot 12,000 ft.

Common 11–15,500 ft. on fields, and less often on high open slopes. In large flocks.

@ **Dendrotreron hodgsoni** : Speckled Wood Pigeon.

♀ 23-8-50 Bimta Kothi 10,000 ft.

Several seen in open mixed forest.

**Streptopelia o. orientalis** : Rufous Turtle Dove.

♀ 13-7-50 Manangbhot 12,000 ft. ; ♀ 30-7-50 Khangsar 13,000 ft.

In coniferous forest up to 13,000 ft.

@ **Ithaginis c. cruentus** : Blood Pheasant.

♂ 29-8-50 Bimta Kothi 12,000 ft.
In birch woods. Locally well known and named *Chilme.*

@ **Alectoris graeca chukar** : Chukor.

♂♂ 26-6-50 and 3-7-50 Manangbhot 12,000 ft.
Quite plentiful on fields 10–13,000 ft. Young seen in June.

@ **Perdix h. hodgsoniae** : Tibetan Partridge.

♂ 5-7-50 Jargeng Khola 14,000 ft.; ♂ (imm.) 29-7-50 Khangsar 14,000 ft.
In juniper scrub. Very noisy in the mornings.

**Tetraogallus himalayensis** : Snowcock.

Snowcock were common between 14,000 and 16,000 ft. in Manangbhot during July and August.

**Lophophorus impejanus** : Monal Pheasant.

♀ 29-8-50 Bimta Kothi 13,000 ft.
Sparingly above the tree line. Does not occur in the dry zone.
[In Sikkim not recorded above 15,000 ft.—N.B.K.]

@ **Tringa ochropus** : Green Sandpiper.*

During July solitary Green Sandpipers were seen on several occasions on the river-shingles in the valley near Braga.

@ **Scolopax rusticola** : Woodcock.

Woodcock were observed 'roding' at Thonje, 6,500 ft. on 25 May.

@ **Mareca penelope** : Wigeon.*

A solitary cock Wigeon in full breeding plumage was seen on a small pond on 11 June. It was most unwilling to fly and had presumably been injured.

@ **Nyroca ferina** : Pochard.*

A small party of Pochards was seen on another pond on 10 June; the drakes in breeding plumage.

A few other duck and teal were observed (on passage ?) on several occasions early in June.

# HEDGEHOGS OF THE DESERT OF RAJASTHAN

BY

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AND

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## PART 1. FOSSORIAL HABITS AND DISTRIBUTION

*(With four text-figures)*

### INTRODUCTION

Although the fossorial habits of many insectivores (moles and shrews etc.) have been studied to some extent, those of hedgehogs have not been studied so far. In this country particularly even their distribution has not been satisfactorily studied. Among the earlier workers, Herrick (1892) and Wood (1910) have studied only certain aspects of the fossorial habits of moles. The former has described their digging habits to be 'swimming through the earth'. Wood (1910) remarked: 'the burrows of the moles are always excavated not by bringing dirt to the surface but by pushing it aside.' Later on Hisaw (1923) and recently Reed (1951) have described in detail the method of their digging and shoving of the soil.

Coming to the question of their distribution in this country, Jerdon (1867), Blanford (1888-91), Wroughton (1918), Prater (1948) and Ellerman and Morrison-Scott (1951) have recorded the presence of these animals on a very broad basis. The details are lacking and also these workers have not mentioned anything about the population density of these animals.

This study, therefore, has been attempted in order to collect further information. The distribution was studied last summer (1954) during our tour of the desert. The tour was undertaken under a UNESCO scheme to study the role of vertebrates in spreading and preserving the desert conditions. We are highly grateful to UNESCO for the financial help. Information on distribution was also collected through the officers of the Government of Rajasthan, and those of the Anti-Locust Department (Directorate of Plant Protection, Government of India). The fossorial and feeding habits were studied in Pilani under the patronage of the Birla Education Trust, for which we are thankful to its Secretary, Shri S. D. Pande. We also acknowledge the help given by the Government departments and various organisations and express our gratitude to them and also to those individuals who helped us in various ways from time to time. Our thanks are also due to Shri K. S. Pradhan of the Zoological Survey of India and to its Director for helping us with necessary literature.

### TECHNIQUE

Owing to their nocturnal habit, hedgehogs are not easily collected during the day time. They are generally found in the evenings under hedges. In a village or outside a town they are often seen under lamp posts, where they come to feed upon insects and toads. During the day they have to be dug out of their burrows. For the present study they were kept in captivity and also in semi-captivity. For the former condition they were kept in large cages (90″ × 30″ × 30″) with a thick layer of sand at their bottom; for the latter they were left in a closed courtyard (15′ × 20′). For the study of the burrow its roof was removed and the burrow was covered with a glass pane. After this change, too, the hedgehogs continued to use the tunnel.

## DISTRIBUTION

According to our collections and the reports received, there are two species of hedgehogs found in this region: 1. *Hemiechinus auritus collaris* Gray 2. *Paraechinus micropus micropus* Blyth. The former is spread all over the desert. It is less abundant in the northern and western regions

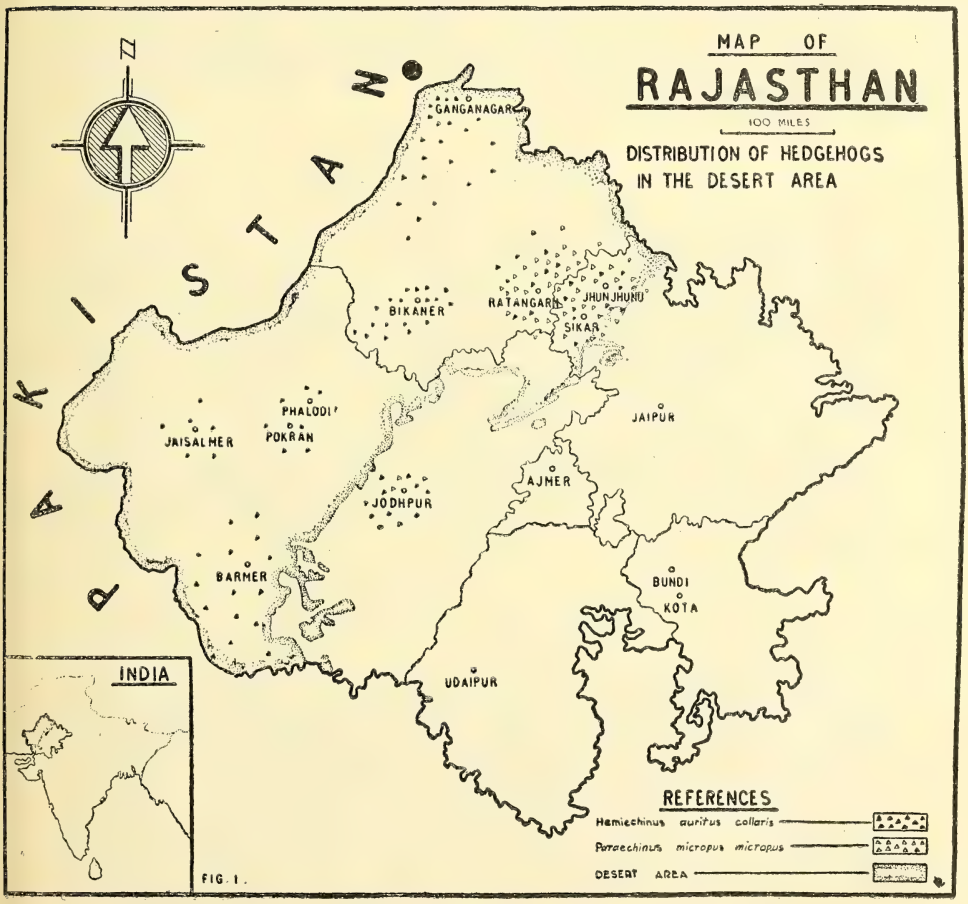
MAP OF
RAJASTHAN
100 MILES
DISTRIBUTION OF HEDGEHOGS
IN THE DESERT AREA
N
PAKISTAN
GANGANAGAR
BIKANER
RATANGARH
JHUNJHUNU
SIKAR
PHALODI
POKRAN
JAISALMER
JAIPUR
AJMER
JODHPUR
BARMER
BUNDI
KOTA
UDAIPUR
INDIA
REFERENCES
Hemiechinus auritus collaris
Paraechinus micropus micropus
DESERT AREA
FIG. 1.

FIG. 1

(Ganganagar, Bap, Phalodi, Jaisalmer and Barmer) than in the southern and eastern ones (Ratangarh, Jhunjhunu, Bikaner and Jodhpur). *P. m. micropus* is confined to the north-eastern part (Ratangarh and Jhunjhunu), where it is more abundant than even *H. a. collaris.* Our catches have shown that *P. m. micropus* are twice as abundant there as *H. a. collaris.* Here the collection was made at three different places for a fixed period at each one (three days) in the months of August and September. The catches revealed that the sex ratio for both the species in these months was 3 males to 1 female.

Jerdon (1867) and Blanford (1888-91) did not record *P. m. micropus* from Rajasthan, and have mentioned that this variety occurred only in the South India (Trichinopoly and Coimbatore etc.). At that time the sub-species *micropus* and *nudiventris* were not separated and were included under a common name *micropus*, which had a full specific rank. The accounts of Jerdon (1867) and Blanford (1888-91) are correct for the *Paraechinus micropus nudiventris* Horsfield but not for *P. m. micropus.* The other reason for their omission could be that they collected material from Barmer, Jaisalmer and Ganganagar only, where we also have not observed this sub-species. Later Wroughton (1918) has recorded the presence of *P. m. micropus* from this northern part of Rajasthan and has described Bahawalpur as its type locality. The type locality for *H. a. collaris* was not yet spotted out.

## GENERAL HABITS

Hedgehogs are nocturnal and during the day they remain inside their burrows rolled up as a ball. They come out at dusk and remain active for about 5 to 6 hours. They retire to their burrows at mid-night. When touched, or sometimes even when approached, they roll up in an impregnable ball of spines, withdrawing their snout and limbs. After some time they slowly and cautiously open out. When a stick is inserted in their burrow they make a hissing noise. Probably this is an adaptation to mimic snakes which are generally regarded to be dangerous animals. In captivity also they make a similar noise when they are touched to pick up and also react with an upward jerk as they are touched. When the animal is moving its spines are directed backwards, but as it rolls up they stand erect due to the stretching of *musculus orbicularis.*

## FOSSORIAL HABITS

Hedgehogs spend most of their life under the ground. They inhabit small burrows dug by themselves. These burrows are invariably found under a hedge or a dense bush, but never in open ground and in loose soil. These subterranean homes follow a fixed plan. They are simple straight pouches in the earth with only one opening. Their inner blind ends are slightly dilated and there is no 'bolt run' (Fig. 2). The burrows are usually 1 to 1½ ft. long but in Bikaner, where the soil is looser than in Jhunjhunu, 4 to 5 ft. long burrows have also been observed. Ordinarily only one individual lives in a burrow, except in the breeding season when the female lives with her offspring till such time as they are old enough to dig their own burrow. To accommodate the young, the female widens the blind (distal) end of the burrow (Fig. 3). In semi-captivity *P. m. micropus* made an abnormal burrow in which three individuals used to live (Fig. 4). The following are the dimensions of the burrows :—

| | |
|---|---|
| Length | 12″ to 24″ |
| Diameter of opening | 2·5″ to 4″ |
| Diameter of distal dilated end | 3·5″ to 5″ |
| Diameter of the distal blind end of burrow of female hedgehog in breeding season | 4·5″ to 7″ |
| Depth | 8″ to 14″ |

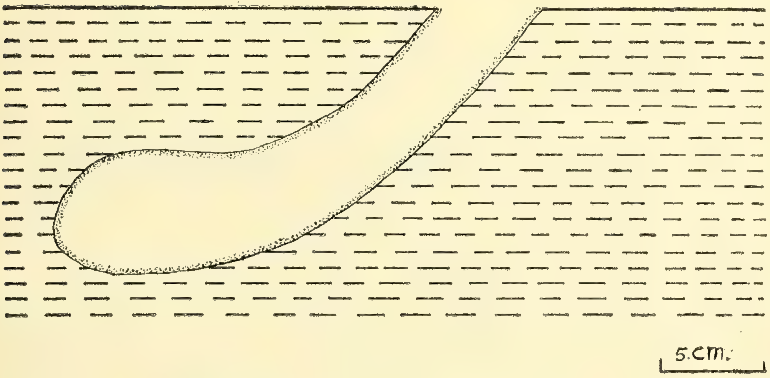

FIG. 2

Burrow of hedgehog. Common in nature. Vertical Section.

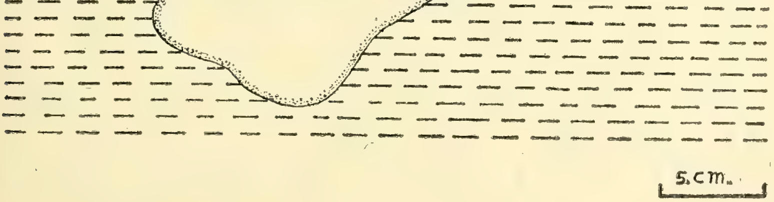

FIG. 3

Burrow of female hedgehog in breeding season. Vertical section.

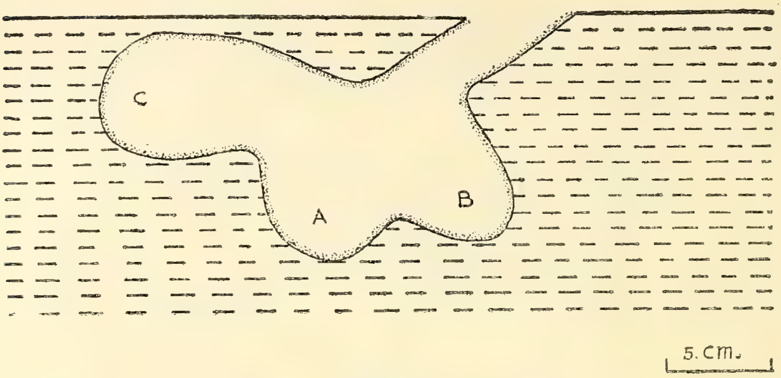

FIG. 4

Abnormal burrow of hedgehogs, dug by three *Paraechinus micropus micropus*. A was dug first, then B and C were dug by two other individuals. Vertical Section.

Hedgehogs enter their burrow head first and while doing so they project the anterior portion of the *musculus orbicularis* over the snout to protect it from any injury. The animal lies in the burrow in two positions : 1. Half rolled up, 2. fully stretched. In its return journey also, the snout comes first. The turning inside the narrow burrow is done by pressing the body sideways.

During the process of digging, hedgehogs loosen the earth by lateral strokes of the fore-limbs, which are armed with broad spade-like claws. These strokes are so powerful that the sand is thrown to a considerable distance behind the body. Shoving of dirt is thus achieved by the powerful strokes of the fore-limbs till the burrow is 6″ to 7″ long. Thereafter, when the burrow reaches a length of about a foot, the hedgehog backs up to the middle of the burrow in ' reverse gear ' and kicks the sand out by the rapid alternate action of the hind-limbs. A small hill of sand is formed at the opening of the burrow. The hedgehog now comes to the opening by moving in reverse and shoves away the hill also, again with its hind-limbs. In semi-captivity *P. m. micropus* were not observed to dig their own burrows. They always preferred to remain under logs and dense branches of bushes. Sometimes they chose the burrows dug and vacated by *H. a. collaris*. In nature, however, the *P. m. micropus* were always found in burrows. *H. a. collaris*, on the contrary, always dug their burrows themselves. When the earth is sufficiently hard they usually complete digging their 12″ to 15″ long burrow in 3 to 4 hours.

The method of digging of these animals is similar to that of the moles, *Scalopus aquaticus machrinoides* (Hisaw, 1923), *Scapanus latimanus latimanus* (Reed, 1951) and *Neurotrichus* (Reed, 1951). No other insectivore has been recorded by naturalists to shovel like these animals. The talpine mole, *Scapanus latimanus latimanus* shoves the earth by ' using one outthrust hand as a pusher, with the neck and thorax bent to one side and locomotion achieved by use of the other three limbs ; this same posture is maintained when pushing dirt out onto the surface. Under such conditions the hind-limbs would be performing the major part of locomotor effort ' (Reed, 1951). About the shoving by *Neurotrichus*, Reed (1951) states : ' It does not however, bring dirt to the surface to form mole hills, nor does it seem to transport dirt through a burrow as will a true mole ; presumably it always excavates in such soft earth that a burrow can readily be constructed by pressing the dirt aside.'

Cuvier (1817) wrote that there is a special bone in the nose of the mole, *Talpa europea*, which the animal uses for digging. But Reed's remarks are to the contrary. He writes : ' I can only say that there is no special ' digging ' bone in the nose of *Scapanus latimanus* and *Neurotrichus gibbsii*, and I doubt if any other mole has one.' Other observers have also not recorded the presence of the special bone which Cuvier (1817) mentioned (J. G. Wood, 1859 ; Herrick, 1892 ; Stephens, 1906 ; Slonaker, 1920).

Skulls of these hedgehogs were also examined, and no such special bone has been observed. Moreover, the hedgehogs have never been observed using their snouts for digging purposes.

## SUMMARY

1. Fossorial habits of two species of hedgehogs found in the desert of Rajasthan are described ; also their method of tunnelling.

2. The distribution of *Hemiechinus auritus collaris* Gray and *Paraechinus micropus micropus* Blyth in the desert of Rajasthan is given.

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# NOTES ON A COLLECTION OF FISH FROM THE HEADWATERS OF THE BHAVANI RIVER, SOUTH INDIA

BY

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## INTRODUCTION

Two collections of fish were made at different periods in 1954, from the Bhavani and Moyar rivers and some of their tributaries. The first collection, mainly from the Moyar watershed, was made from February to April. The second collection was made from both the rivers from September to November. Since the collection is fairly representative of the area surveyed, it is intended to report on it. The Bhavani River drains the southern and the Moyar River the north-eastern face of the Nilgiri Hills.

Since the publication of Day's volume on Fishes in the Fauna of British India series (1889) the only other comprehensive list of fishes of the Nilgiri and Wynaad Hills is that given by Hora (1942)[1]. The present collection, which comprises 2380 specimens, can be referred to 48 species and was made at different altitudes. Above 5000 feet, only specimens of *Danio* Hamilton, *Rasbora* Bleeker, *Tor* Gray and *Noemacheilus* van Hasselt were collected, while these and the other genera given in the list below occur at lower altitudes. Naturalised species, namely, *Carassius carassius* (Linnaeus); *Cyprinus carpio* (Linnaeus) var. *communis* and var. *specularis*; *Tinca tinca* (Bloch) and *Gambusia affinis* Baird and Girard were obtained from the Ootacamund Lake while *Salmo levenensis* Walker[2] was collected from the Krurumund River.

## LOCALITIES

For the sake of brevity, the localities are tabulated as follows:—

| *No.* | *Localities* | *No. of Stations* |
|---|---|---|
| 1. | Bhavani River, between Chindaki and Bhavanisagar | 29 |
| 2. | Kunda River | 2 |
| 3. | Taimalai Stream | 1 |
| 4. | Pykara River, between Mukurti Dam and Wood Estate | 5 |
| 5. | Krurumund River | 1 |
| 6. | Moyar River, between Moyar Division of Government Cinchona Plantations, Naduvatam and Gazalhatti | 6 |
| 7. | Stream running through Devarshola Estate, crossing the Gudalur Sultan Battery Road at Mile 4/3 | 2 |
| 8. | Stream in Devon Estate, Devarshola | 2 |
| 9. | Stream below the Tea Experiment Station, Devarshola | 2 |
| 10. | Stream in Kekkanhalla | 1 |
| 11. | Sandy Nullah River | 1 |
| 12. | Kokkal Stream | 1 |
| 13. | Siruvani River | 1 |

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[1] Hora, S. L., *Rec. Ind., Mus.*, 44. pp. 193-200 (1942).
[2] Misra, K. S., *Rec. Ind. Mus.*, 45. p. 412 (1947).

## LIST OF SPECIES

| *Name of Species* | *Number of Specimens* | *Standard Length in mm.* | |
|---|---|---|---|
| | | *Minimum* | *Maximum* |
| Family Cyprinidae | | | |
| Sub-family Abramadinae | | | |
| 1. *Chela atpar* (Hamilton) | 222 | 31.25 | 82.00 |
| 2. *Chela laubuca* (Hamilton) | 11 | 34.00 | 56.75 |
| 3. *Oxygaster argentea* (Day) | 172 | 25.25 | 99.75 |
| 4. *Oxygaster clupeoides* (Bloch) | 19 | 64.25 | 99.00 |
| Sub-family Rasborinae | | | |
| 5. *Barilius bendelisis* Hamilton | 4 | 52.50 | 74.00 |
| 6. *Barilius gatensis* (Valenciennes) | 175 | 19.25 | 89.00 |
| 7. *Danio aequipinnatus* (McClelland) | 882 | 15.00 | 83.25 |
| 8. *Esomus barbatus* (Jerdon) | 136 | 38.25 | 71.25 |
| 9. *Rasbora daniconius* (Hamilton) | 55 | 22.50 | 72.75 |
| Sub-family Cyprininae | | | |
| 10. *Amblypharyngodon melettina* (Valenciennes). | 103 | 42.00 | 68.25 |
| 11. *Puntius amphibius* (Valenciennes) | 26 | 45.25 | 88.00 |
| 12. *Puntius carnaticus* (Jerdon) | 37 | 23.00 | 250.00 |
| 13. *Puntius chola* Hamilton | 5 | 62.00 | 77.50 |
| 14. *Puntius curmuca* (Hamilton) | 1 | 43.75 | |
| 15. *Puntius dorsalis* (Jerdon) | 1 | 31.25 | |
| 16. *Puntius dubius* Day | 3 | 91.00 | 107.50 |
| 17. *Puntius filamentosus* (Valenciennes) | 4 | 33.00 | 56.50 |
| 18. *Puntius jerdoni* Day | 3 | 46.50 | 61.25 |
| 19. *Puntius melanampyx* (Day) | 18 | 26.00 | 48.50 |
| 20. *Puntius micropogon* (Valenciennes) | 5 | 82.00 | 169.00 |
| 21. *Puntius pulchellus* (Day) | 16 | 36.25 | 95.00 |
| 22. *Puntius sarana* (Hamilton) | 10 | 76.50 | 106.00 |
| 23. *Puntius sophore* Hamilton | 33 | 43.75 | 56.25 |
| 24. *Puntius ticto ticto* Hamilton | 164 | 14.75 | 50.00 |
| 25. *Tor khudree* (Sykes) | 2 | 98.00 | 200.00 |
| 26. *Osteochilus* (*Kantaka*) *brevidorsalis* (Day) | 8 | 54.75 | 126.25 |
| 27. *Osteochilus* (*Osteochilichthys*) *nashii* (Day) | 1 | 36.00 | |
| 28. *Labeo kontius* (Jerdon) | 31 | 94.50 | 156.00 |
| Sub-family Garrinae | | | |
| 29. *Cirrhina reba* (Hamilton) | 25 | 89.00 | 140.00 |
| 30. *Garra mullya* (Sykes) | 16 | 21.50 | 112.00 |
| 31. *Garra jerdoni* (Day)[1] | 31 | 73.00 | 125.00 |
| 32. *Garra stenorhynchus* (Jerdon) | 72 | 26.00 | 120.00 |
| Family Cobitidae | | | |
| 33. *Lepidocephalus thermalis* (Valenciennes) | 11 | 25.00 | 48.75 |
| 34. *Noemacheilus beavani* Günther | 9 | 33.00 | 49.75 |
| 35. *Noemacheilus denisonii* Day | 2 | 30.75 | 32.75 |
| 36. *Noemacheilus guentheri* Day | 1 | 52.00 | |
| 37. *Noemacheilus monilis* Hora | 2 | 46.00 | 46.75 |
| Family Siluridae | | | |
| 38. *Ompok bimaculatus* (Bloch) | 1 | 259.25 | |
| 39. *Silurus berdmorei wynaadensis* Day | 1 | 99.00 | |
| Family Bagridae | | | |
| 40. *Mystus cavasius* (Hamilton) | 3 | 97.25 | 118.50 |
| 41. *Mystus malabaricus* (Jerdon) | 3 | 79.75 | 81.00 |
| 42. *Mystus punctatus* (Jerdon) | 1 | 320.00 | |
| 43. *Mystus vittatus* (Bloch) | 18 | 54.00 | 73.00 |

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[1] Silas, E. G. Revision of Jerdon's work 'On the Freshwater Fishes of Southern India' (1840). (Seen in MSS.)

| | | | |
|---|---|---|---|
| Family Sisoridae | | | |
| 44. *Glyptothorax madraspatanus* (Day) | ... | 9 | 81.75 - 94.75 |
| Family Anguillidae | | | |
| 45. *Anguilla bengalensis* Gray | ... | 1 | 1000.00 |
| Family Gobiidae | | | |
| 46. *Glossogobius giuris* (Hamilton) | ... | 7 | 86.00 - 150.00 |
| Family Ophiocephalidae | | | |
| 47. *Channa gachua* (Hamilton) | ... | 14 | 50.00 - 85.50 |
| Family Mastacembelidae | | | |
| 48. *Mastacembelus armatus* (Lacépède) | ... | 6 | 135.00 - 326.00 |

## Notes on Certain Species

### **Esomus barbatus** (Jerdon)

1928. *Esomus barbatus*, Hora and Mukerji, *Rec. Ind. Mus.*, **30**: 46.

Hora and Mukerji (loc. cit.), while discussing the taxonomy of this species, observed that 'it can be readily distinguished by its characteristic coloration (sides without black, broad, lateral bands) and by the possession of 17 predorsal scales', from *E. thermoicos* (Cuvier and Valenciennes).

In as many as thirty specimens of *E. barbatus* examined, it is found that the number of predorsal scales varies between 17 and 19. Fresh specimens also show a well-defined dark lateral band, about one scale in width, extending from the posterior margin of the orbit or from the operculum to the base of the caudal fin.

Thus it will be seen that both in the coloration and scalation there is considerable intergradation between *barbatus* of Peninsular India and *thermoicos* of Ceylon. As the minor differences noticeable between the two do not seem to be of specific importance, it is best to consider *thermoicos* as a subspecies of the earlier described *barbatus* as treated by Silas (1955).[1]

This species is distributed throughout South India.

### **Puntius carnaticus** (Jerdon)

1932. *Barbus carnaticus*, Mukerji, *JBNHS*, **35**: 164.

In a young specimen examined, there is a clear, dark precaudal spot extending over the penultimate lateral line scale. The outer margins of a few anterior scales along the lateral line show dark pigmentation.

Day (op. cit. p. 305) introduced this species in the Ootacamund Lake, but it seems to have failed to acclimatize itself there as no catch has been reported in recent years.

It is distributed in the rivers along the base of the Nilgiris, Wynaad, Mysore and South Kanara and in the Anamalai and Nelliampathi Hill ranges.

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[1] Silas, E. G., *Bull. Nat. Inst. Sci. India*, No. 5. p. (1955).

### **Puntius micropogon** (Valenciennes)

1941. *Barbus* (*Puntius*) *micropogon* Raj, *Rec. Ind. Mus.*, **43**: 382.

The specimens of *P. micropogon* in the present collection fall under group 3 as given by Raj, but they exhibit slight variations, which may be partly due to their smaller size. The number of scales along the lateral line are 41 and 42, and the L. tr. is 7½ 11/4-5. The diameter of the eye is contained 1.25 to 1.75 times in the snout.

The distribution of this species is in the rivers around the base of Nilgiris, Wynaad, Mysore and South Kanara. A subspecies, *viz. P. micropogon periyarensis* Raj has been described from the Periyar River in the Travancore Hills.

### **Labeo kontius** (Jerdon)

1889. *Labeo kontius*, Day, Fauna, Brit. India, Fish. **1**, p. 264.

Since the specimens show some variations in the range of certain characters from Day's description, a brief account of the species is given below.

The length of the head is contained from 4.80 to 5.86 times in the total and 3.74 to 4.46 times in the standard length. The snout is contained 1.94 to 2.36 times in the head length. The eyes are situated 1.57 to 2.46 diameters behind the tip of the snout, and are 3.73 to 5.07 in the head length and 1.80 to 2.50 in the inter-orbital distance. The height of the body is contained 4.04 to 5.46 times in the total and 3.19 to 4.00 times in the standard length. There are 14 to 16 (3/11–13) dorsal fin rays. The number of lateral line scales ranges from 39 to 42; and the predorsal scales from 15 to 17. There are 8 to 9½ rows of scales between the dorsal fin and the lateral line; 5½ to 6½ rows between the lateral line and pelvic fin and 6½ to 7½ rows between the lateral line and the origin of the anal fin. Scales round the caudal peduncle number 21 or 22 along the narrowest part.

*L. kontius* is distributed in Nilgiris and Mysore.

### **Noemacheilus monilis** Hora

1921. *Nemachilus monilis*, Hora, *Rec. Ind. Mus.*, **22**: 19.

This is the first record of this beautifully coloured loach from the Bhavani river (Siruvani, a tributary stream) after its discovery in 1921.

In all essential features the two specimens in the present collection agree with Hora's detailed description except in the number of dorsal fin rays, which is 3/8 in one of the specimens. This would mean that in *N. monilis* the dorsal fin ray count is 3/7–8.

### **Mystus malabaricus** (Jerdon)

1889. *Macrones malabaricus* Day, Fauna Brit. India, Fish. **1**. p. 160.

In most of the characters it conforms to Day's description of the species, except with regard to the pectoral and anal fin ray counts. The former shows a count of 1/7 *versus* (Day : 1/9). In the latter the number of rays varies from 11 to 13 (3–4/8–9) *versus* (Day : 2–3/8).

The species is distributed from Ratnagiri District in Bombay State down to Travancore.

### **Mystus punctatus** (Jerdon)

1889. *Macrones punctatus* Day, Fauna Brit. India, Fish, **1**., p. 153.

One specimen of *M. punctatus*, 320 mm. in length was obtained from the Moyar river at Mangalapatti. The specimen was taken on hook, which was laid at dusk and removed next morning. The predaceous nature of this species is seen from the fact that the stomach was found to contain a full-sized specimen of *Garra stenorhynchus* (Jerdon) 103 mm. in length and a severed head (25 mm. long) of the same species of *Garra*.

### **Glyptothorax madraspatanus** (Day)

1889. *Glyptosternum madraspatanum*, Day, Fauna Brit. India, Fish. **1**., p. 200.
1938. *Glyptothorax madraspatanus*, Hora, *Rec. Ind. Mus.*, **40** : 370.
1951. *Glyptothorax madraspatanus*, Silas, *JBNHS*, **50** : 368.

Nine specimens of *G. madraspatanus* were collected, of which five are females and the rest males. Since they show differences from Day's description and as the body proportions of adult males and females seem to differ in certain characters, a brief description of the species giving these details is appended below.

The length of the head is contained 4.86 to 5.54 (♂ 5.14–5.54 ; ♀ 4.86–5.21) and the depth of the body 4.93 to 8.04 (♂ 6.20–8.41 ; ♀ 4.93–6.70) times in the total length and 3.71 to 4.22 (♂ 3.87–4.22 ; ♀ 3.71–4.04) and 3.81 to 6.52 (♂ 4.71–6.41 ; ♀ 3.82–5.08) in the standard length respectively. The occipital process is 2.18 to 4.42 times as long as wide at its base. The dorsal spine is serrated at its upper third anteriorly and all along its posterior margin. The caudal peduncle is 1.68 to 2.17 times as long as high and the 'adhesive disc' on the ventral surface is 1.28 to 1.55 times as long as wide. The general body colour is yellowish grey, being darker on the head and anterior part of the body. There are two broad, transverse lighter bands, one from below the tip of the dorsal fin extending to about the middle of the adipose dorsal and the second from below the last third of the adipose dorsal to the base of the caudal fin. There is a black band at the base of the caudal fin followed by a broad white band. Each caudal lobe has a black band and the tips are white. The rayed dorsal, adipose dorsal, pectoral, pelvic and anal fins are tipped white. There is a dark band at the upper half of the dorsal fin extending along the first three rays. The ventral surface is dirty white. The region of the disc is yellowish. In gravid females the colour pattern is lighter while in mature males the entire dorsal surface is dark greyish.

*G. madraspatanus* is distributed in the Nilgiris and parts of Mysore.

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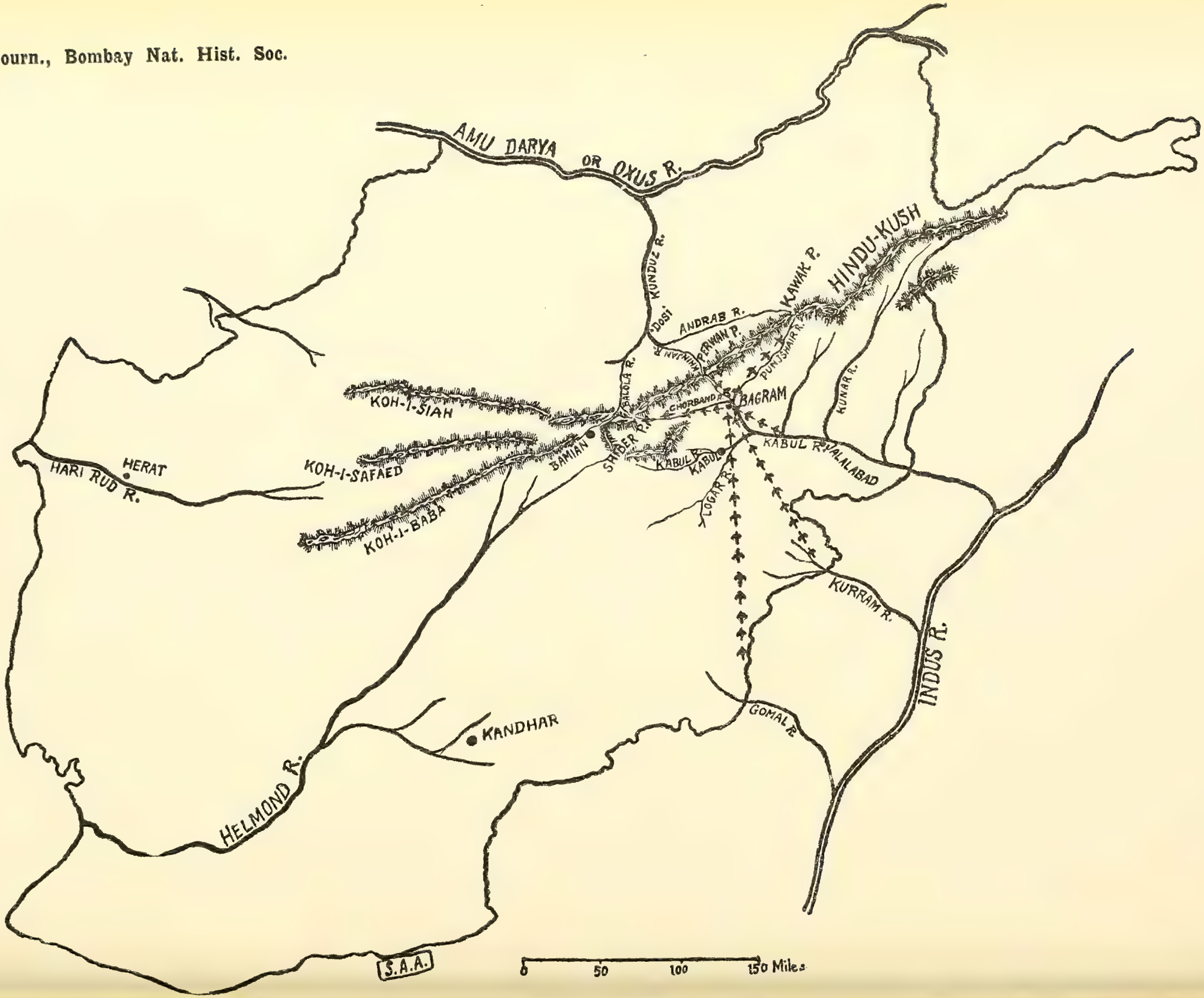
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KANDHAR
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HELMOND R.
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0
50
100
150 Miles

showing the probable route taken (arrows) by most of the spring migrants crossing Afghanistan.

# BIRD MIGRATION AND FOWLING IN AFGHANISTAN

BY

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(*With a map*)

It is a well known fact that in the northern hemisphere, birds have their breeding quarters in the northern parts and winter quarters near the Equator. Absence of an adequate food supply in winter is by itself enough to account for emigration; and return from the south in spring is probably due to the desire of birds to re-occupy their old homes in which they have been bred. By means of migration they avoid the rigours of the northern winter while they are able to enjoy the long hours of the northern summer when rearing their young. There can be little doubt that during migratory movements visual clues play an important if not exclusive part; and the majority of birds adopt routes along the river courses where they are provided with food as well as drink. [ ? EDS. ]

It is not intended here to discuss the birds as a whole, but to examine the conditions of those species which have their summer quarters north of the Himalayas and their winter quarters south of that range. It is quite possible that the bulk of the migratory birds from Siberia, after spending winter in India pass round the Himalayas either east or west. No great migratory movements have been observed via any of the big Himalayan valleys between Kashmir and Sikkim. The Himalayan extension towards south from Kashmir to Quetta appears to offer no obstacle except the Sulaiman Range, if that is of any importance, but nowhere have the migrants been observed so plentifully as at the lower end of the Kurram Valley. Here in the months of February and March are found vast quantities of wildfowl, waders, gulls etc. on passage to their far-off northern homes from the lower reaches of the Indus and the Manchar Lake in Sind. Whitehead remarks: 'The majority of these birds undoubtedly keep to the river-route, there being no other important waterway lying near that line of migration, and must therefore of necessity pass up the Kurram Valley.'

The migrants from Sind etc. thus enter Afghanistan through the Kurram Valley which leads them to the upper basin of the Kabul River in which it flows with its tributaries, the Logar, the Ghorband and the Punjshair. It is relatively flat country and, beginning from the Logar Valley, it stretches northwards through the Kabul Valley and the Kohdaman Valley up to the Kohistan Valley. But it is bounded on the north by the lofty range of the Hindukush, which forms a natural barrier the migrants have to meet in crossing Afghanistan. It is a western offshoot of the Himalayas, stretching westwards from Pamir to Bamian where it breaks up into several almost parallel branches. It rises far in the region of perpetual snow but has certain points along it less high, forming many passes of which one, the Perwan Pass (at present known as the Salung

Pass), has a great importance in connection with the migration of birds.

The head of the Salung Pass is the source of two opposite flowing rivers, the Khinjan and the Perwan (at present known as the Jubbal-us-siraj River). The former, flowing down its northern slope, joins its tributary the Andrab, and a little farther the Ballola or Bamian River, and then becomes the Kunduz River which flows further northwards into the Oxus. Thus it forms to some extent a flight line, as it may be called, beyond the Hindukush. The Jubbal-us-siraj flowing down the southern slope joins its tributary the Ghorband River, and a little farther the Punjshair River. Farther beyond the Kohistan Valley it joins the Kabul River which afterwards flows eastwards into the Indus. Thus an almost continuous waterway is present over the Hindukush at the Salung Pass. This pass provides the shortest route into Afghan Turkestan and lies just in front of and along the flight line from the head of the Kurram Valley and along the Logar River. Sultan Baber remarks : ' (The Perwan Pass) . . . is the grand pass up the Hindukush, and there is no other pass but itself in this vicinity. On that account all the game ascends the mountain by this route '. Incidentally it is interesting to note that the remarks of Whitehead regarding the Kurram Valley are almost identical with those of Sultan Baber regarding the Salung Valley made about five hundred years earlier.

Just as the birds, during their northward journey before ascending the Kurram Pass, make a halt on their way at Bannu in the open, similarly before ascending the Salung Pass they make a halt at Bagram, and every one who has visited the place at the appropriate time has been struck by the great abundance of birds there. It is quite possible that birds coming up from the southeast along the Kabul River, and those coming up through the Gomal Pass, may be further added to the number arrived from the south through the Kurram Pass. Thus large flocks of duck, teal, lapwings, herons, pelicans, etc., come and make a halt at Bagram. Alexander Burns made ' a collection of no less than forty-five different species of ducks, and it was quite evident,' he says, ' that many additions might have been made'. Tamerlane on his way to India, finding immense numbers of birds, took back with him fowlers from Multan on his return journey. They were installed in about two or three hundred houses and were called slave-fowlers. There is still a village near Bagram which is known as Syyadan ( = fowlers,) and mostly inhabited by them.

Leaving Bagram aside let us look over the whole of the upper basin of the Kabul River. In addition to rivers there are places here and there where in early spring snow-water accumulates forming large shallow lakes. There are two or three such lakes or marshes about Kabul City which are the resort of immense numbers of aquatic birds. It is for this reason that the inhabitants, from ancient times, are fond of game and skilful in fowling. Formerly they used to catch big birds by means of springs. A long cord was wound on a stick with a cross handle of horn at one end and a double-pointed arrow at the other. At night when the birds fly low, the stick was taken out and the cordage was thrown over the bird. The cord winding over the neck, wing or leg used to bring the bird down.[1] The practice does not seem to exist today.

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[1] This description is somewhat obscure. Presumably some form of bolas—EDS.

At some places on the Hindukush there are, however, some detached oval ponds specially constructed for catching wild geese and ducks. The plan adopted, though crude, is unique in its way. By the aid of narrow dug trenches or channels, water from the running stream is let into the ponds and turned off when full. The pond is surrounded by a stone wall high enough to allow a man to crouch behind unobserved. Over and across one-half or less of this pond a rough trellis-work of thin willow branches is put up. The birds on alighting are gradually driven under this canopy and a sudden rush is made by those on the watch. In this manner hundreds of birds are caught daily during the season.

In the valleys of Kohdaman and Kohistan another method is adopted for catching ducks. A small hut, covered with reeds etc. is built over a water channel leading off from the main river or the lake on which the birds gather. At night when the ducks are floating about in sleep, the fowler enters the hut and, opening a sluice-gate that divides off the water of the river or lake, strikes a light inside and awaits the ducks. They drift in on the current one by one through the narrow opening and are at once seized by the neck and made *halal*—killed according to Islamic law. In this manner a couple of men can easily secure from a hundred and fifty to two hundred ducks in a single night.

Coots are resident and common in the country. They are caught by means of nets stretched across the channels in the reed-beds. These nets are hung on sticks fixed in the mud, the lower edge being in the water, the upper edge above the surface. The flocks are driven into the nets with the aid of rafts.

With the introduction of fire-arms bird-shooting has become a favourite sport and great havoc is done annually. The rivers and lakes are fringed with shooting boxes—little loop-holed mud-huts built on the edge of the water. Near them are placed many decoy-ducks, dead ones whose bodies are stuffed and attached to sticks fixed in the water. Sometimes they are anchored in their proper position by stones tied to their feet with pieces of cord that reach the bottom. The decoy-ducks which are locally called *maulay*, are so skilfully arranged on the sides of the water that once Alexander Burns, seeing plenty of ducks in the river at Bagram, fired at them, when to his great surprise he found they were but decoys! Often they are arranged in a straight line along the edge of a river or a lake. At night when the fowler finds a bird on either side out of the line he fires at it. The decoy ducks are meant to deceive their fellow birds and they often serve their purpose admirably.

Sometimes another method is employed to counteract the shyness of the birds. Two men with shot-guns creep behind a bullock driven towards the fowls, and when within range fire leisurely over the animal's back at them.

Early in the spring, when the trees are still devoid of leaves, the inhabitants of Kohdaman or Kohistan fix *maulays* to the branches of mulberry trees. These are not stuffed birds but are simply pieces of half-burnt wood. Birds like the starling etc. taking them for their fellow birds descend on the trees where they are easily shot from cover.

Not only are aquatic birds in abundance but other birds like larks, pipits, wagtails etc. are also plentiful during the spring season, hence several kinds of raptorial birds are trapped and trained for falconry. The principal kinds are *Baz* ( ? Goshawk, *Accipiter gentilis*) *Charagh* or Charagh falcon (*Falco cherrug*) and *Shahin* or Peregrine falcon

(*F. peregrinus*) etc. Of these the Baz is the most esteemed and is taught to soar over the falconer's head and strike the quarry as it rises in the air.

Large flocks of Wrynecks, Bluethroats and Pastors arrive in April and May. Vigne has noticed large flocks of Rosy Pastor entering Afghanistan by the Gomal Pass on 27th April. These birds were knocked over by pellet-bows. The bows were made of bamboo and the round pellets were of clay baked in the sun, but now the pellet-bow is nowhere to be seen in the country.

Sparrows are knocked over by means of *poofak* or blow-pipe which is a bored wooden stick about a yard long, its hole not being more than half a centimetre in diameter. A small pill of moist clay is put in at one end and from the other it is blown forcibly by mouth at the bird nearby. But catapults are common and boys are generally seen wandering about with them. They are charged with small gravel to which small birds fall easy victims.

As soon as the quails are 'in', every boy and man turns out with a long thin willow-rod at one end of which there is a horse-hair noose. When a quail is seen crouching under a stone the noose is slowly slipped over its neck and jerked up. Sometimes horse-hair nooses are fastened to lumps of clay which are then scattered around the borders of the fields where the birds are accustomed to run about.

Sparrows, quails and other small birds are caught in large numbers by means of nets thrown over standing corn. Sparrows are said to be caught in such immense numbers in Kohistan that even a widow having nobody to take care of her gets enough birds for one meal at least once a season! The feathers are plucked and the birds are minced flesh and bone together. The dish is greatly relished by the people, and thought to be a kind of tonic, especially for the male sex. All birds that are not consumed locally are brought down to Kabul and sold by the basketful in the markets, as are also all other kinds of birds.[1] In early spring villagers are seen in the early morning coming towards the town with duck, teal, coots etc. hanging by their legs from both hands. Teal are, perhaps, the earliest to arrive as they are seen in the beginning of February when there is no other bird available. If the previous night has been cloudy or rainy the game is more plentiful in the markets. On such days especially, storks, cranes, herons, spoonbills etc. in singles, and snipe, duck, avocets, stilts, coots, teal, grebes and other species in fives, tens or twenties, are seen hanging up for sale in poulterer's shops. From all of which it is evident that passage migrants have to pay a heavy toll in crossing over this country.

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[1] In a letter Dr. Akhtar informs us that not only sparrows, but *all* small birds that fly in flocks, irrespective of species, are netted and sold in bulk in this manner, particularly starlings (Rosy ? ) and wagtails of several species. On an ornithological trip to N. Afghanistan in 1937 (with Col. R. Meinertzhagen) Mr. Sálim Ali observed heaping basketfuls of Short-toed Larks (*Calandrella acutirostris*)—with their throats neatly cut in the approved Islamic way—hawked about for sale in the weekly bazaars.—EDS.

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# A NEW *POLYGALA* FROM SOUTH INDIA

BY

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(*With a plate*)

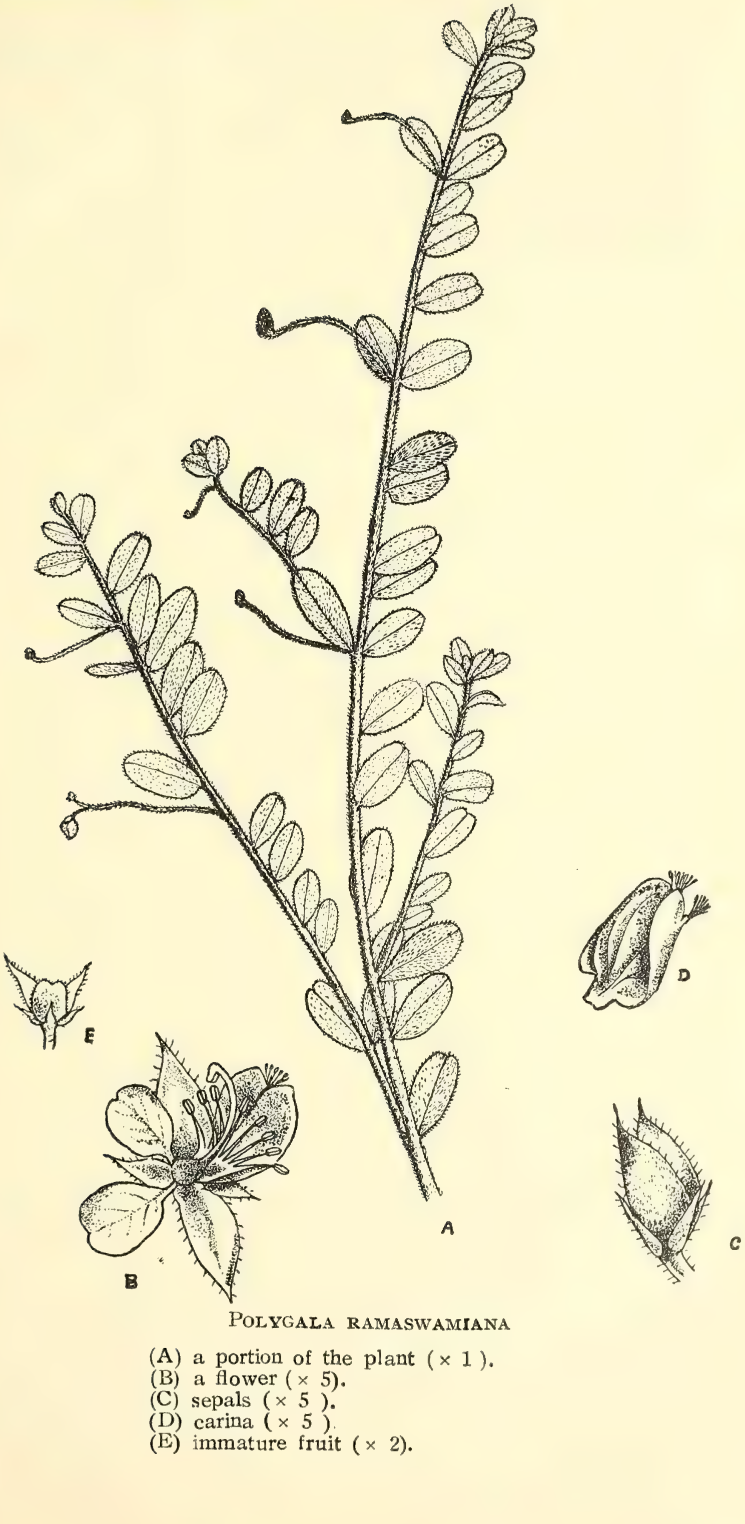
In Prodromus Florae Peninsulae Indiae Orientalis 1: 38, 1834, Wight and Arnott described 14 species of *Polygala.* One of these they designated as *P. ciliata* Linn. But *P. ciliata* of Linnaeus had been found to be a species of *Salomonia* and therefore, it was named as *S. ciliata* (L.) DC. in DeCandolle's Prodromus Regni Vegetabilis 1: 334, 1824, and the binomial—*P. ciliata* Linn. was put as a synonym to *S. ciliata.* But the species described as *P. ciliata* by Wight and Arnott was, however, found to be a true *Polygala* and different from *P. ciliata* Linn, i.e., *S. ciliata* (L.) DC. So S. T. Dunn gave a new name to Wight and Arnott's species and called it *P. bolbothrix* Dunn in *Kew Bull.* 1916: 63, 1916.

Wight and Arnott mentioned two varieties of their *P. ciliata*, viz. var. α and var. β. Under var. α they quoted Wallich's No. 4177 and under var. β they quoted W. Roxburgh's coloured plate No. 675 of *P. arvensis* Willd. This, however, is a figure of *P. chinensis* Linn. Therefore, *P. ciliata* W. and A. var. α is *P. bolbothrix*, and Wallich's No. 4177 becomes the type sheet.

While examining the sheets of *Polygala* in the Calcutta Herbarium the writer has come across a few sheets marked as *P. bolbothrix* Dunn. Among these are two sheets bearing Wallichian number 4177. Other sheets matching exactly with these 2 sheets are: Fischer No. 157*a* from Nerinjipet-Coimbatore, Fischer No. 2187 from Muttipulao Ghat, Coimbatore, and Fischer No. 3480 from Tekkadi, Malabar. In addition to those mentioned above there are a few more, named similarly, but appearing distinct because of being densely hispid all over with long spreading hairs. These are larger and much branched specimens, and have smaller and thicker leaves and smaller flowers. These differ from *P. bolbothrix* and doubtlessly represent a new and hitherto undescribed species.

This species comes close also to another, viz. *P. hirsutula* Arn. a Ceylon plant. Of *P. hirsutula* there are the following sheets in the Calcutta Herbarium, viz.: Thwaites C P. No. 1081 (2 sheets); Thwaites, Ceylon, without precise locality and without number; and T. Thomson, Ceylon, without precise locality and without number. In *P. hirsutula* the hairs are small and decurved, the flowers are larger and the petals longer than the wing-sepals. The raceme is erect while in *P. bolbothrix* and the new species it is more or less horizontal.

The sheets of this new species in Herb. Cal. were examined by W. W. Smith, M. S. Ramaswami and P. Debbarman, and from the remarks made by them on the sheets and on the covers, it appears that they also considered that these were specimens of a new species or variety. The sheets were sent to Kew for confirmation where these were named by Dunn himself as



Polygala ramaswamiana

(A) a portion of the plant (× 1 ).
(B) a flower (× 5).
(C) sepals (× 5 ).
(D) carina (× 5 ).
(E) immature fruit (× 2).

his *P. bolbothrix*. Considering that Dunn only renamed an earlier described species, it is perhaps possible that he did not examine critically Wight and Arnott's *P. ciliata* and, therefore, named the sheets from Calcutta as *P. bolbothrix*, which these resemble to some extent. Depending upon Wallich's No. 4177, of which there are 2 sheets in Herb. Cal. it now becomes possible to study the distinguishing characters separating this from *P. bolbothrix*. Ramaswami prepared a nice sketch of the flower and its parts. The sketch is preserved in this Herbarium along with the dissected parts of the flower. These have been very helpful and I dedicate the species in his honour and call it *P. ramaswamiana*.

Among these sheets, however, some difference is noticed in the leaves. One sheet with smaller leaves and shorter racemes was named by Dunn as *P. bolbothrix* with a question mark. This, I believe, is a distinct variety of the new species which also has a distinct form as is evident from the difference in the shape of leaves in different specimens. The species with its form and variety is described below.

### **Polygala ramaswamiana** Mukerjee sp. nov.

Accedit ad *P. bolbotricem* Dunn structura et aspectu generali, ab ea tamen differt inter alia in eo quod nova species est dense hispida, eiusque folia sunt minora atque marginibus revolutis et nervo medio in superiore pagina depresso, in inferiore vero prominenti ornata.

*Herba* diffuse ramosissima e basi; rami tenues, teretes infra, angulares supra, dense vestiti pilis longis patentibus simul atque pilis brevibus adpressis; rami ascendentes vel erecti, usque 36 cm. alti. *Folia* simplicia, carnosa, alterna, obovata vel elliptica vel lineari-oblonga, rotundata atque saepe breviter emarginata ad apicem, angustata ad basim in petiolum brevissimum, marginibus integris, revolutis, hispida in utraque pagina pilis longis patentibus, hispidiora ad margines, qui sunt hispidi brevibus pilis adpressisque; nervus medius depressus in superiore pagina, prominens in inferiore, lamina 8–18 mm. longa, 4–8 mm. lata. *Racemi* usque ad 8 cm. longi, tenues, horizontales, laxiflori, vel ad apicem densiflori, hispidi longis adpressis pilis, atque hirsuti brevibus pilis adpressis; bracteae binae singulos pedicellos supportant; bracteae 1 mm. longae, deltoideo-lanceolatae, acuminatae, hispidae; pedicelli 3–4 mm. longi; flores purpurei. *Sepala* 5, hispida pilis longis, setacea vel rostrata ad apicem, persistentia; 3 exteriora quidem lanceolata, 1·5 mm. longa; 2 interiora alata, ovata, obliqua 4 mm. longa, 2 mm. lata, angustata ad utrumque apicem, marginibus membranaceis. *Petala* 3, unguiculata, ad basim adnata columnae staminali; petala lateralia orbiculari-oblonga, emarginata; inferius petalum carinatum, ad apicem bilobum, lobis cristatis. *Stamina* 8, filamenta unita infra in vaginam, antherae dehiscent per poros terminales. *Ovarium* orbiculare, compressum, 2-cellulatum; ovula singula in singulis cellulis, pendula. Fructus capsularis, late oblongus, compressus, longitudinaliter sulcatus in medio, apice emarginato, margine dense ciliato pilis longis, haud alatus, 3 mm. longus. *Semina* 2 mm. longa, nigra, levia, oblonga, obtuse truncata ad apicem, tenuiter angustata ad basim, dense operta longis pilis atque albis, carunculata ad basim; carunculus luteus, 3-appendiculatus.

S. India: Peermade, A. Meebold No. 12858 (Type in Herb. Cal.); Without precise locality, A. Meebold No. 13066; Shembaganur, Rev. L. Anglade No. 1859. (per errorem Auglady).

Forma **devicolamensis** f. nov.

Folia anguste oblonga vel lineari-oblonga, flores minoresparvi.

S. India: Devicolam, A. Meebold No. 13185 (Type in Herb. Cal.)

Var. **palniensis** var. nov.

Foliis minoribus, ellipticis vel oblongis nonnumquam lineari-oblongis, racemis brevissimis, floribus minoribus a typo recedit.

Folia 5–11 mm. longa, 2–4 mm. lata, apice rotundata vel obtusa. Racemi usque ad 1·5 cm. longi, pedicelli 2 mm. longi. Flores parvi (?), sepala aliformia 3 mm. longa.

S. India: Kilavare, Upper Palnis, 2,000 mtr., 20-9-1911, C.E.C. Fischer No. 3026 (Holotype in Herb. Cal.).

(I am indebted to Rev. H. Santapau for kindly rendering the descriptions into Latin.—S.K.M.)

# MORE NOTES ON THE BIRDS OF THE NEPAL VALLEY

BY

DESIRÉE PROUD

The following notes are additions and corrections to the lists of birds I published in the *journal.*[1] Since the lists were made we have lived more than 6 years in the Valley, and all possible weekends (alas too few !) are spent camping on Sheopuri or Godavari. During the monsoon of course such camps are not possible because of the leeches, but during the rest of the year we are out as much as possible. I have also collected birds, particularly willow-warblers and wagtails, both of which are a fascinating study here owing to the numbers of different races which pass through on the migrations.

I have kept careful records of the song periods of the Valley birds and prepared a chart of these, after the model of those prepared by Mr. H. G. Alexander and published in the 'Handbook of British Birds'. I have found these very valuable in England, and consider it would be a good idea if readers would send in similar charts for different parts of India.

I append charts of arrival and departure dates for the various migrant birds of the Valley.

The building of a motor road to India has opened up new country, particularly sugar cane fields at about 3,000 ft. This has added new birds to my list. I look forward to the time when the road will be completed and the terai with its swarming bird population within a few hours' drive by car.

**Parus major nipalensis** (Hodgson) : Nepal Grey Tit.

Though not normally found in the valley occasionally there is an invasion of these birds, and I saw a number during the winter of '51, and during March and April of both '52 and '53.

**Parus spilonotus** Blyth : Blackspotted Yellow Tit.

My previous record of this bird must have been a mistake. I have never seen it since.

**Sylviparus modestus** Burton : Yellow-browed Tit.

These little tits are very common on the hills about 7–9,000 ft. They are acrobatic as all tits. They seem to feed almost entirely on the pupae of the *Tortrix* moth or something similar which are found in the curled-up leaves all over the trees here. I have watched them collecting hundreds from infested leaves, and they must do a great deal of good. In appearance and habits they are very like a phylloscopus, and have a thin shrill *zee-zi zee-zi zee-zi* note uttered endlessly in April. For the rest of the year they are rather silent.

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[1] 'Some notes on Birds of the Nepal Valley ', *JBNHS*, 48 : 695–719 , ' More Bird Notes from Nepal Valley.' *JBNHS*, 49 : 784–5,

**Garrulax caerulatus** (Hodgson) : Greysided Laughing-Thrush.

I have found this bird really very common on Sheopuri and Phul Chok, at 8,000 ft. and above, in summer. They make a great disturbance when feeding on the ground, hurling earth and dead leaves in all directions with the vigour of a puppy digging for rats. They have a delightful liquid whistle. In winter they are found at Godavari.

**Garrulax rufogularis** (Gould) : Rufouschinned Laughing-Thrush.

Uncommon but found sparingly all over the lower hills up to 6,000 ft. It has a very beautiful whistle. Found both in dense jungle and thin scrub at such places as Phar Ping.

**Garrulax striatus** Vigors : Striated Laughing-Thrush.

One of the commonest of the laughing-thrushes but only in dense jungle. At Pokhara they were very common up to 8,500 ft. They are often found at fruiting trees in company with green and Speckled Wood Pigeons.

**Stachyris nigriceps** Blyth : Blackthroated Babbler.

Rather scarce, but small flocks often seen at Godavari. I have not yet succeeded in getting a specimen. The call is peculiar, a single note followed by a trill which sounds like a small bell being rung faster and faster, then stopping abruptly.

**Stachyris chrysaea** Blyth : Goldenheaded Babbler.

We found this bird at Pokhara at 8,000 ft., but have not seen one in the Valley.

**Pellorneum ruficeps** Swainson : Spotted Babbler.

Very common in the terai ; I have found them scarce in the Valley, though seen occasionally in Goucher woods during the monsoon and all the year on the lower slopes of Nagar Jung.

**Alcippe castaneiceps** (Hodgson) : Chestnut-headed Babbler.

I previously recorded this little babbler as scarce which it certainly is not. On the higher parts of Sheopuri, Phul Chok and the inner hills from 7–9,000 ft. it is very common indeed. It has a rather distinctive churring purr, which can be very soft, or loud and harsh.

**Pnoepyga pusilla** Hodgson : Lesser Scalybellied Wren-Babbler.

These tiny wrens are common in the Valley especially in dense scrub on steep hillsides. I had spent much time watching them but always failed to get a specimen. They have a maddening habit of appearing just under one's feet, where to shoot would be to blow them to pieces. They then dash into dense cover and remain invisible though the moving leaves all round them give away their presence. Dr. Fleming very kindly gave me a specimen which he shot at 8,000 ft. on Phulchok. They are common at Godavari and Nagar Jung, at about 5,000 ft. and upto 8,000.

**Pnoepyga albiventer** Kinnear : Larger Scalybreasted Wren-Babbler.

This little bird is, I think, much scarcer than the last and found mostly at higher elevations. Like the last species I had failed to get a specimen, but was able to examine a couple shot by Dr. Fleming high on Phulchok, one golden, the other white-breasted. The colour of the underparts is difficult to see in the field, but I think the bird with a white breast is the commoner variety here.

**Siva strigula** Hodgson : Stripethroated Siva.

Abundant all over the hills from 6-11,000 ft. Down to the Valley in winter. The display of this bird in spring is most amusing to watch. I have not seen it described anywhere so include it here. The birds collect into flocks of anything from 15 to 50 birds, and these break up into pairs, but the pairs all remain together in the same tree. The 2 birds of each pair sit very close together, tails on opposite sides of the branch and separated by at least 6 inches from the next pair. They then alternately bow and stretch their heads and necks up to the fullest extent, the feathers of the head and neck fluffed out. They frequently reverse their positions on the branch, and both birds always do this at the same instant as if at a signal so that they never both have their tails the same side of the branch even for a second. The whole thing is like an elaborate dance and will continue for an hour or more without a break. Each pair normally take no notice of any other birds in the tree, but I have occasionally seen one bird leave its partner and commence to bow to the nearest bird of the next pair, this leads to much scuffling and disturbance but the pairs soon re-form, although whether in the original order I am not quite sure. If one pair should leave the tree and fly off all the others follow and the whole thing starts again in another tree, though this is sometimes the signal for the whole thing to break up. All the time this is going on the birds keep up a continual churring note with an occasional sweet whistle. It can be quite deafening when a large number are displaying close to one. The song proper, a sweet 3-syllable whistle, is not heard during the display in fact not until the birds have separated into pairs in preparation for nest building. I have seen this display take place on Sheopuri at 8,000 ft. in April and on the Gandak-Kosi watershed at 11,000 ft. in May. The one essential seems to be a large population of these birds. 8 pairs is the smallest number I have seen doing it. Where they are few, the pairs seem to form without any fuss.

**Siva ignotincta** (Hodgson) : Redtailed Minla.

Scarce but found sparingly on Sheopuri above 7,000 ft. in summer. In breeding condition in May.

**Cutia nipalensis** Hodgson : Nepal Cutia.

Commoner than I at first thought. They keep much to the lanuginosa forest, where they range round the hillsides keeping to the same elevation, about 7,000 ft.

**Pteruthius melanotis melanotis** Hodgson : Chestnut-throated Shrike babbler.

This bird also is commoner than I used to think. It is usually solitary in a large flock of tits, phylloscopi and particularly of Bluewinged Sivas. I have never seen more than one bird in a flock of probably 30 to 50 other individuals. I think they breed on the ridges at 7-8,000 ft., where I have seen them in April and May, but spend the winters in such places as Godavari at 5,000 ft. Never away from forest.

**Pteruthius xanthochloris** Gray: Green Shrike-babbler.

This bird also is commoner than I had thought. The first one I saw was shot by Dr. Fleming. Since then I have seen a number, but they are very silent and unobtrusive, creeping about in dense jungle. They often perch along a branch instead of across it. I have never heard them utter a sound. Mostly at about 7–8,000 ft. throughout the year.

**Aegithinia tiphia** (L.): Iora.

I had previously recorded this bird as a monsoon visitor. Although this is correct for the Goucher area where I had previously observed them, they are found along the south side of Nagar Jung in Simal trees (*Bombox*) as early as March.

**Cinclus pallasii** (Temminck): Brown Dipper.

These birds breed each year on the stream near the dam at Sundarijal. This year the nest was under the fall of water from the dam. When the water was flowing the parent birds had to fly through a curtain of water to reach the nest. When the reservoir was not full and the water was turned off, a good view of the nest was obtained. I much enjoyed watching the young birds leaving the nest on the 17th February.

**Luscinia brunnea** (Hodgson): Indian Blue Chat.

Numbers of these birds nest on Sheopuri at 8,400 ft. They are in full song by the 28th April. They were still singing, though not nearly so much, on the 28th June.

**Luscinia suecica** (L.): Bluethroat.

I had previously recorded this bird as a passage migrant. They are certainly very common on passage, but a few remain throughout the winter in the Valley. They are particularly partial to bean fields.

**Luscinia pectoralis** Gould: Himalayan Rubythroat.

Occasionally seen on passage and a few may remain throughout the winter, as the Common Rubythroat does.

**Phoenicurus ochruros** (S. G. Gmelin): Black Redstart.

These go through rapidly on the spring migration. On 19-4-52 during an afternoon's ride through the fields I must have seen half a dozen individuals. Next day there were none. Some years I never see any.

**Muscisylvia leucura** Hodgson: Whitetailed Blue Robin.

In April and May these birds breed at about 8,000 ft. on Sheopuri. Generally near a stream, and always found in the same areas. I have not found a nest.

**Saxicola caprata bicolor** Sykes: Pied Bushchat.

Not usually seen in the Valley, but in 1953 I saw several birds on some bare eroded cliffs at the foot of Sheopuri. They are very common along the new road as soon as one drops to 3,000 ft.

**Rhodophila ferrea** (Gray): Grey Bushchat.

Much commoner than I had supposed. Breeds on Sheopuri above 8,000 ft. and on all the inner ranges North of the Valley. It is one of the earliest birds to sing in the morning, often heard before 4 a.m. By May 24th many had newly-fledged young sitting about, speckled and lumpy, on low branches. Others were still feeding young in the nest.

**Turdus m. albocinctus** Royle : Whitecollared blackbird.

I think that none of these birds remain to breed on Sheopuri or Phulchok or anywhere below 10,000 ft. Very common in March ; I have seen none after the 4th April.

**Turdus rubrocanus** Gray : Greyheaded Thrush.

Very uncommon here. I have seen them only twice at about 7,000 ft. in winter. On the other hand they were common on the hills north of Pokhara.

**Oreocincla mollissima** Blyth : Plainbacked Mountain Thrush.

Quite common during the winter, mostly on the ridges where I have seen it at 8,000 ft. in coldest weather with snow on the ground, but it occasionally comes down to 5,000 ft. at Godavari. This I think is the thrush which breeds and sings at 12,000 ft. on the Gandak-Kosi watershed.

**Monticola cinclorhyncha** (Vigors) : Blueheaded Rock Thrush.

Not a passage migrant as I had previously thought, but a summer visitor breeding on Nagar Jang and in a few other places, but rather local. Young birds are seen all over the south side of Nagar Jung from about the end of June.

**Prunella strophiata** (Blyth) : Rufousbreasted Accentor.

A few birds seen each year on the ridges north of the Valley at about 7,000 ft. On the inner hills north of the Sheopuri lekh they are very common in winter, and breed at 12,000 ft. on the same hills.

**Siphia parva hyperythra** (Cabanis) : Kashmir Redbreasted Flycatcher

This flycatcher with black bands bordering the red breast was seen once in my garden on April 10th 1953. I am surprised to find one so far east on the migration.

**Siphia parva albicilla** (Pallas) : Eastern Redbreasted Flycatcher.

Winters in large numbers in the Valley. I am puzzled over the reason why birds with red breasts are seen only in spring during the migration. I read that Mr. Betts found the same thing as stated in his ' Birds of Coorg '. In the Nilgiris I have seen red-breasted birds all winter ; perhaps the western race. This year I did in fact see a bird with a very red throat at Godavari on 30th Jan., but this is the only one seen during 6 winters here. I have also seen very few during the autumn migration. Where do the adult males winter ?

**Hemichelidon cinereiceps** (Hodgson) : Ferruginous Flycatcher.

Scarce but seen a few times at about 8,000 ft. A breeding male was shot at that height on Sheopuri on May 17th.

**Muscicapa amabilis** (Deignan) : Rustybreasted Flycatcher.

A fairly common bird during the winter and early spring. Sir Norman Kinnear tells me that males frequently breed in female plumage and certainly one sees a dozen ' females ' for one adult-plumaged male.

**Muscicapa hyperythra** (Blyth): Whitefronted Blue Flycatcher.

Much commoner than I had at first supposed. They arrive towards the end of April and move up into the hills at 7–8,000 ft. Last year we found a nest. Both parents were building on April 25. The nest was built into a lump of moss suspended from a tree about 20 ft. from the ground, and so looked like a hanging nest with a dome. I should think this must be an unusual situation. We only saw the female incubating, but did not have time to watch for long. Both parents were feeding young on the 26th May. The 2 young birds had their heads sticking out of the hole. They had a very mealy appearance, and one—I suppose a young male—already had a very distinct white bar across the front of his face.

**Nitidula hodgsoni** (Moore): Pigmy Flycatcher.

Rather scarce, but as it keeps to dense forest and is very unobtrusive, it may well be often overlooked. I have only seen them from Phulchok at about 7–8,000 ft. in summer, down to valley level in winter. They are sometimes in mixed flocks with phylloscopi.

**Muscicapula leucomelanura** (Hodgson): Slatyblue Flycatcher.

**Muscicapula tricolor.** Since the opening of the new road we have found these flycatchers common in winter in the sugar cane fields at 3,000 ft. or so. In summer they are much more sparingly distributed in the higher hills.

**Niltava sundara** (Hodgson): Rufousbellied Niltava.

Quite common in thick jungle in summer, in more open country in winter. I have heard it utter a sqeaky grating song, certainly not a fine song. It is much like that of the Small Niltava (*N. macgrigoriæ*) also common here. The Large Niltava (*N. grandis*) although found in deep forest on very steep hillsides is much the rarest of the three.

**Pericrocotus ethologus** (Bangs & Phillips): Longtailed Minivet.

All birds that I have shot have been of this species. I do not know if the Shortbilled Minivet (*P. brevirostris*) is found here also.

**Pericrocotus flammeus** (Forster): Orange Minivet.

Quite a common bird from 5–9,000 ft. but only in forest. It does not fly through the gardens of the Valley as the last species does.

**Dicrurus aeneus** (Vieillot): Bronzed Drongo.

This drongo is common on Nagar Jung, but I have seen it nowhere else. It is not found above about 5,000 ft. They are very active spritely birds, and it is a joy to watch them with their brilliant iridescent plumage flashing in the sun as they dive and swoop through the jungle.

**Phylloscopus affinis** (Tickell): Tickell's Willow-Warbler.

Common passage migrant during March–April, and September. Only on hills; I have not seen it in the Valley.

**Phylloscopus pulcher** Blyth: Orangebarred Willow-Warbler.

Common on the high hills, especially in *Quercus semecarpifolia* forest from October to March. In very cold weather they come down to the

Valley at 5,000 ft. where there is forest. They move on to the higher inner hills above 9,500 ft. at the end of March and first week of April. I do not think any remain to breed on Sheopuri and Phulchok.

**Phylloscopus inornatus inornatus** (Blyth) : Yellowbrowed Willow-Warbler.

Not very common, but a fair number pass through in the autumn and spring. I have obtained them in October–November and end March–April. They can be distinguished sometimes in the field by their notes. Although they utter the double *chee-wee* like *humei*, they have also a single note *wheet* as described by Dr. Ticehurst, and this is uttered frequently enough to be a good field character. I have never heard this bird or *humei* utter any song.

**Phylloscopus inornatus humei** (Brooks) : Hume's Willow-Warbler.

The common willow-warbler of the Valley in winter ; abundant in every sort of country except deep forest. They arrive in October and spread all over the Valley in every garden and clump of trees, and on the open hillsides up to 7,000 ft. there seems to be a bird in every isolated bush or tree. They remain till the end of April.

**Phylloscopus proregulus chloronotus** (Gray) : Yellowrumped Willow-Warbler.

Very common in winter in the valley, and I have found fair numbers in breeding condition on the ridges round the Valley at 7–9,000 ft. at the end of May, so I have no doubt they breed here and move down to valley level in winter. They appear in the Godavari forest at the end of October and leave by the 12th of April, but they do not come into our gardens until November. They are always in little flocks during the winter. They commence their feeble but pleasing little tinkling song in the middle of February and continue to sing until at least the end of May.

**Phylloscopus maculipennis** (Blyth) : Greyfaced Willow-Warbler.

These birds also breed on the ridges round the Valley as we have found them there in breeding condition on 28th May and my husband shot one on 28th June, 8,000 ft. They come down to the Valley in winter and are then fairly common at Sundarijal and Godavari. They do not come into gardens and are not found much below 5,000 ft.

**Phylloscopus magnirostris** Blyth : Largebilled Willow-Warbler.

We have shot this bird in breeding condition on Sheopuri in forest at the end of April, but I have only seen one or two, and they might still be on migration for higher hills. We did not find them on the Gandak-Kosi watershed in May. In August they appear in large numbers in the gardens of the Valley and remain there for about a month. Their unmistakable note is then heard every morning in our garden and they also sometimes sing a little in September. They are the only willow-warblers seen in the Valley during the monsoon. I imagine they breed in thick forest on Sheopuri and Phulchok and move down into the Valley after breeding. I have never seen or heard them in the Valley in spring, and they cannot be easily overlooked with their very striking song. Earliest date in Valley 8th August ; latest September 9th.

**Phylloscopus trochiloides trochiloides** (Sundevall) : Dull-green Willow-Warbler.

We found these birds very common on the Gandak-Kosi watershed at 9,500–12,000 ft. Those shot were in breeding condition. I do not think any remain to breed on the hills round the Valley, nor are they ever found in the Valley in winter. I think they must pass through rapidly on migration as I have only obtained very few then—in our garden 17th and 23rd September and 7th Oct. ; on hills at 7,000 ft. 30th April.

**Phylloscopus trochiloides viridanus** Blyth : The Greenish Willow-Warbler.

This bird is an abundant passage migrant from early March until the middle of May. During late April and May they sing continuously. I find the call note indistinguishable from that of *P. inornatus humei*, but I have collected carefully all winter and have never obtained one of these birds between mid-November and March. They pass through quite rapidly during the autumn migration and do not linger as in the spring. Last date 20th May.

**Phylloscopus trochiloides ludlowi** Whistler.

A single bird shot on Sheopuri at 8,000 ft. on May 31st and in breeding condition was identified by Sir Norman Kinnear as an intergrade between this race and *P. t. trochiloides*. This is the only one I have seen, and presume a straggler from further west. As it was in forest and fairly low, it would in any case not overlap with *trochiloides* which is not found in summer below 10,000 ft. and usually in more open country—small bush type of country.

**Phylloscopus trochiloides nitidus** Blyth : Green Willow-Warbler.

A very common passage migrant in spring, but never seen in autumn. They begin to arrive in the Valley in the last days of March, but are not common till the middle of April, when hundreds go through, all singing with a bubbling vehemence unusual in willow-warblers on passage. They are found everywhere, in gardens, orchards, trees along river banks and on the hills in light jungle to 8,000 ft. at least By the first week of May most are gone, but I have seen a few on 5th May in our garden. The call note is indistinguishable from that of other races of the *trochiloides* group, but the song is different and could be easily recognised by anyone with a good ear.

**Phylloscopus reguloides reguloides** (Blyth) : Blyth's Willow-Warbler.

A common breeding bird on the hills round the Nepal Valley. They arrive early in March and are then found from 4,000 ft. but only in dense forest. By the end of April they are established in their breeding haunts at about 8,000 ft. and are singing lustily. The song is distinctive—a continuous little trill of 9 or 10 notes *Chi-ti-chi-ti-chi-ti-chi-ti-chee.* Sometimes the last note also is double.

I have never obtained a specimen of *P. subaffinis* collected here by Dr. Ripley, but have seen what I believe to be this bird on Nagar Jung and at Godavari in April and November. I may possibly be confusing it with *affinis*.

**Seicercus poliogenys** (Blyth) : Greycheeked Flycatcher-Warbler.

Very scarce. A few seen in our garden during November amongst other warblers.

**S. castaneiceps** (Gray). Chestnutheaded Flycatcher-Warbler.

Not very common but odd ones are seen in winter at Godavari and on the hills amongst flocks of willow-warblers, etc.; also sometimes in our garden.

**Abrornis schisticeps** (Hodgson) : Blackfaced Flycatcher-Warbler.

Not nearly as uncommon as I had thought, but local. In summer they are really common on Sheopuri at 7-8,000 ft. where I have frequently seen them in April and May in small flocks of generally 4 or 5 birds, probably family parties. Presumably breeding takes place early in the year. They seem to have an affinity with *Sylviparus modestus*, as these two species are nearly always found together. In the winter they form part of the huge mixed flocks which wander round the hillsides and are sometimes seen at Godavari. But there are not usually more than 1 or 2 of this species, and they then seem scarce.

**Neornis flavolivaceus** Blyth : Aberrant Bush-warbler.

This bird is absolutely abundant round Pokhara at all elevations from 2,500 to 6,000 ft., but I had never seen it in the Valley until the opening of the new road enabled us to get down to sugar cane fields at 3,000 ft. There this bird is certainly very common in winter.

**Horeites brunnifrons** (Hodgson): Rufouscappped Bush-warbler.

This bird breeds on the hills north of the Nepal Valley at 10,000–12,000 ft. and one would expect it to be common in the Valley in winter, but I have never found it here, only occasionally on the hills in spring on passage. On the other hand we found this little bird also very common round Pokhara at 4,000 ft. in November. I suppose the grass conditions in the Valley are somehow not right for it.

**Prinia criniger criniger** (Hodgson) : Brown Hill-warbler.

Very common on grassy hills round the Valley, but local. It is very common above Pharping and on open slopes of Sheopuri. In the monsoon when the grass is long it breeds on Nagar Jung. They must breed late as we have seen parents with just-fledged tailless young on October 4th.

**Prinia gracilis** Franklin : Franklin's Wren-warbler.

Another species added to my list by the opening of the road. Never seen in the Valley ; it is abundant in sugar cane at 3,000 ft., below the Valley.

**Tesia cyaniventer** Hodgson. Slatybellied Wren.

Once these birds' habitat is known they are found to be very common. They frequent the dense low undergrowth round small mountain streams running through forest. I have seen them mostly about 5–6000 ft.

**Oligura castaneocoronata** (Burton). Chestnut-headed Wren.

Not quite as common as the last species, but found in the same situations and often in company with it. I have found it up to 7000 ft. I must say that from the field naturalist's point of view these birds seem much more happily placed with the wrens than with the warblers.

**Pyrrhula erythrocephala** Vigors : Redheaded Bullfinch.

Small flocks seen on Sheopuri in April and May at 8,000 ft.

**Pyrrhula nipalensis** (Hodgson) : Brown Bullfinch.

Common on both Sheopuri and Phulchok in winter and as late as early May, but I doubt if any remain to breed here.

**Spinus tibetanus** (Hume) : Tibetan Siskin.

This bird must, I think, be extending its range. For the last two years numbers have been seen in the Valley. It is however very local, and I have only seen them at Godavari where they frequent the huge alders growing by the stream. This year, on 27th and 28th Feb., these trees were literally swarming with them and the twittering they made was so loud that from a distance it sounded almost like starlings going to roost. After watching them for some time I began to count, the main flock had passed on, but I counted 58 stragglers. There must have been several hundred birds. I did not see any after the first week in March.

**Carpodacus rodochroa** (Vigors) : Pinkbrowed Rosefinch.

Very common on Sheopuri in winter and early spring when the rhododendrons are out. I have not seen them below 8,000 ft. They have all left by the middle of April.

**Carpodacus erythrinus** (Pallas) : Common Rosefinch.

Very common from March until the middle of May. They swarm in our garden on the *Prunus puddum* trees whose fruit is ripe then. Nearly all are the race *erythrinus* I think, and have only the upper breast rosy. I have seen only one bird shot in the Valley with the rosy extending as far as the abdomen.

**Uroloncha striata acuticauda** (Hodgson) : Hodgson's Munia.

I had always thought this bird to be a summer visitor only to the Valley, but this year ('53) large numbers remained in my garden all December and January. During this time they built huge untidy straw nests in which numbers roosted at night. On the new road we found them very common round sugar cane fields, so their migrations are obviously only of a very local nature.

**Emberiza aureola** Pallas : Yellowbreasted Bunting.

I had thought this bird to be a passage migrant only, but find that large flocks winter in the Valley. They are also very common in fields at 3,000 ft. along the new road. They begin to change into breeding dress in the middle of February and are in full plumage by the middle of March. A flock of these birds feeding in a ploughed field is a most pleasant sight, the yellow and brown bodies and flicker of white in the wings gives life to the winter landscape.

**Delichon nipalensis** Horsf. & Moore : Nepal Martin.

Not often seen in the Valley but common over the low grassy passes in the inner hills. I think they breed on the cliffs above Golbu at 7,000 ft.

**Ripara paludicola** (Vieillot): Sand Martin.

The common Sand Martin of the Valley. The breeding season must be an extended one as I have seen them flying in and out of the nest-holes as early as February and as late as May. These holes are in the mud cliffs which border the river beds, and are often in a crumbling condition. Some of the holes are very large and are obviously used year after year. My previous record of *Riparia riparia* in the Valley must have been a mistake.

**Motacilla alba** L. White Wagtail.

This wagtail is really a fascinating study as no less than 6 races are found here at various times. I have collected carefully during the last two years and kept notes of all arrival and departure dates. It is impossible, I think, to distinguish young birds in the field and even in the hand they are difficult, but I think I can now spot the adult birds with fair certainty. The chief difficulty is in winter when the black-backed forms may lose the black back for a grey one. However, a large proportion retain the black back and even in those which do not, the grey is distinctly darker in the black-backed forms. They may sometimes be mistaken in the field, but are always distinguishable in the hand. The following are the races which I have observed and collected here.

*M. a. personata* Gould : Masked Wagtail.

Certainly the rarest form seen here, a mere straggler on the migrations. I have not seen above 6 birds in 3 winters.

*M. a. ocularis* Swinhoe : Streakeyed Wagtail.

Tolerably common on migration. I have only seen one in the autumn, in October, but they begin to appear in early March, and then for the next 2 months a few are generally seen any day on the river bank in company with Indian White Wagtails. Earliest date March 12th; latest April 25th. They can be picked out fairly easily in the field, the dark eye-streak being clearly seen with glasses in all plumages.

*M. a. dukhunensis* Sykes. Indian White Wagtail.

Probably the commonest of all the wagtails. Although less common on sandbanks in the rivers than the 2 black-backed forms, they spread widely over the ploughed fields and the total population must be enormous. They start arriving about 22nd September and are common from the 28th of the month. They are the last to leave in spring, being common to the 30th April, and a few are seen till the 6th of May. During April the resident birds are augmented by large flocks of passage migrants.

*M. a. baicalensis* Swinhoe: Swinhoe's White Wagtail.

This is the most difficult of the white wagtails to distinguish in the field. With young birds it is impossible, and adults are difficult. I am much indebted to Mrs. Lushington who examined numbers in the British Museum and sent me her notes. I have since collected several which have been identified as *baicalensis*. The chief thing to notice is the greater extent of white in the wing; and the general appearance of the bird, especially in breeding plumage, is altogether whiter. A few of these birds winter here, but they become much commoner in spring. For a short time in March they are as common in river beds as the White Wagtail. They are less common in April and very few are seen after the 20th of the month. Last date 30th April.

*M. a. alboides* Hodgson : Hodgson's White Wagtail.

This bird starts arriving on 22nd and 23rd of September and by the end of the month is abundant all along the river banks. It is not seen very much away from the rivers, though odd ones are present in ploughed fields, and numbers will swarm in a flooded area. They are abundant all winter, but start to leave early and the numbers decrease rapidly after 20th March, by the end of the month all are gone. Only a single odd one is seen occasionally during the first fortnight of April. As these birds breed in the Himalayas I suppose their breeding areas are habitable long before those which go to the far north.

*M. a. leucopsis* Gould : Whitefaced Wagtail.

This bird is also extremely common all winter and is the first to arrive, early birds appearing on 13th Sept., a week before the others. By the 20th they are abundant and remain so all winter. Like *alboides* they leave early, and by the end of March they are all gone, nor have I ever seen a single straggler in early April.

**Motacilla flava** L. Two races of this wagtail occur, though not in anything like the numbers of the last species.

*M. flava beema* (Sykes): Indian Blueheaded Wagtail.

This bird is found in small numbers along the river banks and in fields all winter. They first arrive about 19th September. They are frequently seen with White and Yellowheaded Wagtails. About the middle of March large numbers of passage migrants augment the numbers of wintering birds, and for about a week they are very common feeding largely in fields of flowering mustard. They are all gone by the end of the month.

*M. flava thunbergi* Billberg : Greyheaded Wagtail.

A passage migrant only. This year there were about 30 birds in the dry bed of the Vishnumati on 29th and 30th April. Only 2 birds seen on 4th May and then no more. My husband was in the terai that week and he said he saw enormous flocks of these birds along the Kosi River on the same dates. A few days later he saw only one or two.

**Motacilla citreola** Pallas : Yellowheaded Wagtail.

Passage migrants, particularly in the autumn when numbers were seen in the rice fields along the Manora River on 6th September, the first wagtails to appear. They remained in large numbers throughout the month and a few were seen during the winter. I am not quite sure of the race although I think it is *calcarata* ; but I have a few skins and must check them on my next leave.

**Anthus roseatus** Blyth : Roseate Pipit.

This pipit breeds in large numbers on the hills above 10,000 ft. north of the Valley. It is abundant in the Valley all winter and even more so in the sugarcane fields at lower elevations. It is also very abundant on passage. Remains until early May.

**Alauda gulgula** Franklin : Little Skylark.

A common winter visitor arriving about Oct. 10th and spreading all over the ploughed fields. Their rich gurgling chirrup is a pleasant sound throughout the winter. I have never heard them sing here. They are common till the end of March and flocks were seen roosting in swampy fields as late as 21st April. On the bare hills north of Sheopuri I saw a small flock of about 8 birds on the 10th April, possibly on migration.

**Aethopyga saturata** (Hodgson): Blackbreasted Sunbird.

Quite common at Godavari. They leave for a couple of months in the coldest weather but are back and singing by the end of February. Always near forest.

**Aethopyga nipalensis** (Hodgson) : Nepal Sunbird.

Extremely abundant on all the ridges round the Valley at 7–9,000 ft. At first I confused it with Mrs. Gould's Sunbird, but although in the last few years I have examined all birds carefully with glasses and seen numbers shot, I have never seen a specimen of *Ae. gouldiae* and wonder if perhaps the 2 species do not occur in the same area ? The 4 species *ignicauda*, *nipalensis*, *saturata* and *siparaja* are all found together in winter, feeding on flowering *Leucosceptrum canum* and later *Caryopteris*, but *gouldiae* is never found with them.

**Pachyglossa melanozanthum** Blyth : Yellowbellied Flowerpecker.

Seen occasionally in our garden and on the lower hills of Nagar Jung, and Pharping during the winter December to February.

**Iynx torquilla** L. : Wryneck.

A passage migrant seen in gardens, and particularly in the lines of willows bordering the rivers, in September, October and March, April.

**Cuculus poliocephalus** Latham : Small Cuckoo.

Common on the ridges about 7,000 ft. and also at Godavari 5,000 ft. They arrive late and I have not heard the call, so like a cackling hen, before the end of April.

**Cuculus sparveroides** Vigors : Large Hawk-Cuckoo.

This is the cuckoo so common at 7–9,000 ft. which puzzled us for so long. The call is much pleasanter than that of the Common Hawk-Cuckoo, not having the piercing crescendo of the latter bird's call.

**Surniculus lugubris dicruroides** (Hodgson) : Drongo Cuckoo.

Fairly common in the Valley, but not heard much above 5,000 ft. My husband found it abundant and calling in the terai in early May, and I imagine we are on the extreme upper limit of its range.

**Chalcites maculatus** (Gmelin) : Emerald Cuckoo.

Seen only once, a small party in our garden on 7th September.

**Megalaima haemacephala** (Müller) : Coppersmith.

I had previously thought this bird to be only a monsoon visitor to the Valley, but find it is resident wherever banyan trees grow, that is, at Pharping and at the village of Bara Nil Kanta at the foot of Sheopuri at 5,000 ft. It is here in the coldest winter.

**Coracias benghalensis** (L.) : Indian Roller.

Never seen in the Valley, but along the new road within a mile of the edge of the Valley, and less than 1,000 ft. below it is quite common.

**Harpactes erythrocephalus** (Gould) : Redheaded Trogon.

I found a pair of these lovely birds breeding at about 6,000 ft. up the Valley to the west of Godavari where a small stream runs through dense forest.

**Ketupa zeylonensis leschenault** (Temminck) : Brown Fish-Owl.

Common at Gowkarna. Last year they used to leave the forest and fly across to the bare slopes of Gowkarna hill at exactly the same time every evening. During the last fortnight of August it was 6·45 exactly. Sometimes only one bird, sometimes several, evidently a family party. We have also seen them at the foot of Nagar Jung and shot one there on October 4th.

**Otus bakkamoena** Pennant : Collared Scops Owl.

Common in the Valley. Its soft interrogative *Wūt ?* is heard almost throughout the year. It is very nocturnal and never calls before it is quite dark. In the light of a torch its eyes look quite red. It is a shy little bird but is occasionally seen by day, fast asleep in some dense shrubbery.

**Otus spilocephalus** (Blyth) : Spotted Scops Owl.

Common on all the hills where it calls for hours at night. At Godavari we hear it from February onwards. They are commonest from about 6–8,500 ft. The note *phew phew* rings out all night but ceases before dawn, and we have never succeeded in actually seeing one. Dr. Fleming obtained 2 on Phulchok by imitating the call and attracting it within range. He very kindly gave me one.

**Glaucidium cuculoides** (Vigors) : Barred Owlet.

Very common in jungle and on the edges of it, but never in gardens in the Valley. It is particularly common at Godavari and on Nagar Jung. The tamest of the owls and very diurnal. They do not call at night, but are very noisy at dawn and for a couple of hours after the sun is up. The call rather reminds me of a barbet. In winter I have seen them in bright sunlight catching insects on the ground in a small swamp at Godavari.

**Glaucidium brodiei** (Burton) : Pigmy Owlet.

Very common indeed on all the hills from 4–9,000 ft. Calls mostly by day and all day, and throughout the year, June and July being the only months when I have not heard them. They are not heard in the Valley away from jungle, although common on the edge of it.

**Aquila chrysaëtos** (L) : Golden Eagle.

Golden Eagles are seen fairly often in the winter, sometimes in pairs flying over Nagar Jung. These are sight records only based entirely on the flight of the bird with wings raised above the back and very different indeed from the stiff vulture-like flight of the Steppe and Imperial eagles.

**Aquila heliaca** Savigny : Imperial Eagle.

A very dark eagle almost purple black in colour with short vulture-like tail and broad stiff wings, the primaries very separated like the fingers of a hand, is seen often in January and February. I take it to be of this species.

**Aquila nipalensis** Hodgson : Steppe Eagle.

The eagle with 2 wing bars, larger than the last bird and with slightly less stiff flight is very common in the Valley all winter, 3 or 4 often seen soaring together particularly over the broad part of the river before it cuts its way out of the Valley by the gorge of Chorbar. My husband shot one this winter, but I have not yet had a chance of comparing it with others in a museum, and all my identifications of eagles are rather doubtful.

**Hieraëtus pennatus** (Gmelin) : Booted Eagle.

This is the only eagle of which I am certain (except for the common and unmistakable Black and Serpent eagles). This bird has been seen several times perched on one of the huge pines in our garden. It is here throughout the year, most eagles being merely winter visitors. Last June one perched in our garden was furiously attacked by 2 pairs of drongos which had nests in the garden. The eagle snapped at them furiously and I thought their end had come, but in the end the drongos were victorious and the splendid bird rose in disgust and sailed away.

**Pernis** sp. ?

A honey buzzard is common here in winter between November and March. We also saw it frequently in Pokhara, but I have not been able to get a specimen and do not know what species or race it is.

**Accipiter virgatus affinis** Hodgson : Besra Sparrowhawk.

Moderately common in our garden all the year, and one was shot last September while devouring a small bird.

**Columba pulchricollis** Blyth : Purple Wood Pigeon.

Scarce. I have only seen them on the ridge of Sheopuri at 8,400 ft. A male shot 20th May was in breeding condition.

**Columba hodgsonii** Vigors : Speckled Wood Pigeon.

This pigeon is really quite common. It wanders a great deal and appears wherever the various fruit are ripe in the jungle. Last March I watched one for some time gorging on the green berries of a wild olive. It was beside a path where wood-cutters were constantly passing. When they appeared the bird would freeze in whatever position it was sometimes almost upside down. Not one of the many coolies noticed this large bird within a few feet of their heads.

**Streptopelia decaocto** Frivalszky: Ring Dove.

Not normally seen in the Valley, but at the end of the monsoon flocks appear and gorge on the ripening rice.

**Arborophila torqueola** (Valenc.) : Common Hill Partridge.

Not uncommon on the hills at about 8,000 ft. They are very secretive and I have watched them hiding under leaves and bushes when disturbed. A male shot on May 24th was in breeding condition.

**Arborophila rufogularis** (Blyth) : Rufousthroated Hill Partridge

This bird occupies the zone below the last and is commonest about 5-6000 ft.

**Burhinus oedicnemus indicus** (Salvadori): Indian Stone-curlew

Seen once only in the Valley, 28th August. It was standing on our lawn after dark obviously bewildered in the glare of the headlights.

**Sterna hirundo tibetana** Saunders : Common Tern

Seen only during the autumn migration on the Manora River. Sometimes they remain a day or two when the river is in spate at the end of the monsoon. An immature bird shot on August 9th. Several seen early September.

**Tringa glareola** L. : Wood Sandpiper

A passage migrant common on both spring and autumn migrations. Usually 4 or 5 birds together, but I have seen an occasional solitary bird.

**Tringa nebularia** (Gunnerus) Greenshank

Seen only on the autumn migration, when it is fairly common from the end of August to the middle of September.

**Philomachus pugnax** (L.) : Ruff & Reeve

On passage in autumn. A number on the Manora on Sept. 16. 2 birds shot were both males, one in golden and one in grey plumage.

**Erolia temminckii** (Leisler) : Temminck's Stint

Common all winter on the Manora River and on the Bagmati where it widens before cutting its way out of the Valley. I have never seen it on the smaller rivers.

They arrive about the 8th August and for the next 3 weeks swarm all along the river banks, little flocks constantly rising with their purring twitter. By the end of August the main migration has passed on, but wintering birds remain. I have seen them until 17th May when they are in full breeding dress. They are therefore absent for less than 3 months.

**Anhinga melanogaster** Pennant : Indian Snake-bird

Seen only once soaring over the Valley after a severe dust storm, on 16th April. A Neophron vulture was soaring with it, both obviously storm driven as neither normally occurs in the Valley.

**Anas querquedula** L. : Garganey Teal

The common duck of the Valley in winter, though most are passage migrants, passing through in large numbers in September and early October. This year I saw 2 ducks in a small pool in the growing rice as early as August 1st. No more were seen until 7th September.

In the following charts I have divided the migrant birds into Summer and Winter Visitors and Passage Migrants. Many birds, of course, are both winter visitors and passage migrants. I have put them into whichever group they appear the most numerous.

## SUMMER VISITORS

| Species of bird | First dates | Last dates |
|---|---|---|
| *Luscinia brunnea*<br>Blue Chat. | 15-4-53, 27-3-54 | |
| *Geokichla citrina*<br>Orangeheaded Groundthrush. | 12-4-48, 8-5-49, 20-4-52, 2-5-53 | 26-9-52, 8-10-53 |
| *Monticola cinclorhyncha*<br>Blueheaded Rockthrush. | early April '53, 5-4-54 | 8-10-53 |
| *Muscicapa sibirica*<br>Sooty Flycatcher. | 11-4-52, 19-4-53, 8-4-54 | 2-11-52, 1-11-53 |
| *Muscicapa latirostris*<br>Brown Flycatcher. | 1-4-52, 27-4-54 | 20-9-53 |
| *M. hyperythra*<br>Whitefronted Blue Flycatcher. | 22-4-51, 19-4-53 | |
| *M. superciliaris*<br>Whitebrowed Blue Flycatcher. | occasionally end February, early March | |
| *M. rubeculoides*<br>Bluethroated Flycatcher. | 11-4-48, 17-4-50, 22-4-53 | 20-9-53 |
| *M. thalassina*<br>Verditer Flycatcher. | 25-3-48, 22-3-51, 16-3-52, 23-3-53, 6-3-54 (odd bird) main body 19-3-54 | 5-10-53 |
| *Culicicapa ceylonensis*<br>Greyheaded Flycatcher. | mid February, local migration a few miles below Valley | mid October |
| *Tersiphone paradisi*<br>Paradise Flycatcher. | 19-3-48, 4-4-52, 24-3-53, 26-3-54 | 12-9-48, 8-9-53 |
| *Coracina melaschista*<br>Dark Cuckoo-Shrike. | 23-2-53, 27-2-54 | all gone 2nd week Oct. local migration to foothill |
| *Oriolus oriolus*<br>Golden Oriole. | mid April | first week September |
| *Sturnus malabaricus*<br>Greyheaded Mynah. | mid March | gone by first week November |
| *Hirundo rustica*<br>Common Swallow. | mid February | most gone by end August |
| *Apus affinis*<br>House Swift. | 29-2-48, 25-2-52, 12-2-54 these records are for birds flying high almost out of sight. They do not appear flying round the houses till the 11th—12th March | mid October |

SUMMER VISITORS—(*contd.*)

| Species of bird | First dates | Last dates |
|---|---|---|
| *Turdus unicolor*<br>Tickell's Thrush | April | end October |
| *Phylloscopus reguloides*<br>Crowned Willow-Warbler. | mid March | mid September |
| *Passer rutilans*<br>Cinnamon Sparrow. | Seen only rarely March to September | |
| *Passer domesticus*<br>House Sparrow. | early March but most in April | August |
| *Nectarinia asiatica*<br>Purple Sunbird. | 1-6-48, 1-6-51, 2-6-52, 1-6-53 I do find it astonishing that this bird should arrive year after year on almost exactly the same day | mid November |
| *Dicaeum concolor*<br>Plaincoloured Flower-pecker. | mid March | end September |
| *D. agile*<br>Thickbilled Flower-pecker. | end June | mid October |

WINTER VISITORS

| Species of bird | First dates | Last dates |
|---|---|---|
| *Luscinia svecica*<br>Bluethroat. | September 14-9-53 | End April 30-4-54 |
| *Phoenicurus frontalis*<br>Bluefronted Redstart. | end October | 22-3-54 |
| *P. hodgsoni*<br>Hodgson's Redstart. | late October | mid March |
| *P. leucocephala*<br>Whitecapped Redstart. | mid October | April 12th |
| *Tarsiger chrysaeus*<br>Golden Bush Robin. | end October not common till November | March 22nd |
| *Tarsiger cyanurus*<br>Redflanked Bush Robin. | mid October | March 24th in Valley<br>April 12th on hills |
| *Adelura coeruleocephala*<br>Blueheaded Robin. | early November | end February |

WINTER VISITORS—(*contd.*)

| Species of bird | First dates | Last dates |
|---|---|---|
| *Turdus ruficollis*<br>Blackthroated Thrush. | mid November | April 25th |
| *Zoothera dauma*<br>Smallbilled Mountain Thrush. | 25-9-53 | early May |
| *Muscicapa parva*<br>Redbreasted Flycatcher. | 23-9-48, 25-9-53 | 27-4-53 ; all gone by first week May; one 11th May 54. |
| *M. strophiata*<br>Orangegorgetted Flycatcher. | mid November | mid April |
| *M. amabilis*<br>Rustybreasted Flycatcher. | December | end March |
| *Rhipidura hypoxantha*<br>Yellowbellied Fantail Flycatcher. | 20th November | end March. This year I observed a migration taking place, there were at least 25 of these birds flying north along the Gandak-Kosi watershed at 8,000 ft. April 5th. |
| *Lanius tephronotus*<br>Greybacked Shrike. | end October | end April-early May |
| *Lanius cristatus*<br>Brown Shrike. | 24th September | 11th May |
| *Phylloscopus collybita*<br>Chiff-chiff. | end November | end March |
| *Acrocephalus dumetorum*<br>Blyth's Reed Warbler. | 3rd October | 11th May |
| *Seicercus burkii*<br>Blackbrowed Flycatcher-Warbler. | 7th September | April 6th |
| *Oriolus chinensis*<br>Blacknaped Oriole. | Seen January only | ... |
| *Pyrrhula nipalensis*<br>Brown Bullfinch. | middle to end September | early May |
| *Spinus tibetanus*<br>Tibetan Siskin. | end November | end March from Valley later on hills |

### WINTER VISITORS

| Species of bird | First dates | Last dates |
|---|---|---|
| *Carpodacus rodochroa*<br>Pinkbrowed Rosefinch. | ? | mid April |
| *Carpodacus nipalensis*<br>Nepal Rosefinch. | late November often December. | end March |
| *Emberiza pusilla*<br>Little Bunting. | November | early April |
| *E. aureola*<br>Yellowbreasted Bunting. | end November | end April, sometimes May |
| *Alauda gulgula*<br>Kashmir Skylark. | 10th October | 21st April |
| *Motacilla alba*<br>White Wagtail. | 13-9- (*leucopsis*) | May 6th (*dukhunensis*) |
| *M. cinerea*<br>Grey Wagtail. | 13th October | May 10th |
| *M. flava*<br>Greyheaded Wagtail. | 19th September | May 4th |
| *M. citreola*<br>Yellewheaded Wagtail. | 6th September | end April |
| *Anthus hodgsoni*<br>Hodgson's Pipit. | 14th September | 4th May |
| *A. richardi*<br>Richard's pipit. | 19th September | ? |
| *A. roseatus*<br>Reseate Pipit | 7th October | May 3rd |
| *Pachyglossa melanozantha.*<br>Yellowbellied Flowerpecker. | Only December to February. | ... |
| *Psittacula himalayana*<br>Slatyheaded Parroquet. | December | end March |
| *Pandion haliaëtus*<br>Osprey. | 14th September | March |
| *Aquila chrysaëtos*<br>Golden Eagle. | December to February only. | ... |
| *A. heliaca*<br>Imperial Eagle. | December to March | ... |
| *A. nipalensis*<br>Steppe Eagle. | end November to end March. | ... |
| *Circus aeruginosus*<br>Marsh Harrier. | 5-9-48, 6-9-52, 6-9-53 | April |

WINTER VISITORS—(*contd.*)

| Species of bird | First dates | Last dates |
|---|---|---|
| Buteo sp ? | October 8th | mid April |
| *Falco peregrinus calidus.* Peregrine. | 16th September | 18th April |
| *F. tinnunculus* Kestrel. | 20th September | Usually 3rd week April occasional 11th May. |
| *Accipiter nisus* Asiatic Sparrowhawk. | 14th October | March |
| *Tringa ochropus* Green Sandpiper. | 17-8-48, 10-8-53 | about second week May |
| *Actitis hypoleucos* Common Sandpiper. | 8-8-48, 8-8-53 | first fortnight May |
| *Erolia temminckii* Temminck's Stint. | about 8th September | 17th May |
| *Scolopax rusticola* Woodcock. | mid October | early March when often in our garden on migration |
| Snipe (Fantail and Pintail. | about 4th September | early May |

PASSAGE MIGRANTS

| Species of bird | Autumn | Spring |
|---|---|---|
| *Phoenicurus ochruros*<br>Black Redstart. | ? | Between 12th and 20th April |
| *Phylloscopus affinis*<br>Tickell's Willow-Warbler. | September | early March to April 25th |
| *P. trochiloides viridanus* | mid September to early November | early March to May 20th |
| *P. nitidus*<br>Green Willow-Warbler. | not in autumn | last week March to 1st week May, mostly second half April |
| *Carpodacus erythrinus*<br>Common Rosefinch. | scarcely any in autumn | mid March to mid May |
| *lynx torquilla*<br>Wryneck. | September-October | April mostly |
| *Sterna hirundo tibetana*<br>Common Tern. | August-September | not in spring |
| *Numenius arquata*<br>Curlew. | August | |
| *Tringa glareola*<br>Wood Sandpiper. | September | mid April to mid May |
| *Tringa nebularia*<br>Greenshank. | mid August-end September | |
| *Philomachus pugnax*<br>Ruff. | mid September | |
| *Anas querquedula*<br>Garganey. | all September-mid October | |

# THE FUNCTION OF ZOOLOGICAL GARDENS IN THE PRESERVATION OF WILD LIFE

BY

E. P. GEE, M.A., C.M.Z.S.

(*With four plates*)

## SYNOPSIS

Distinction between zoological gardens and zoological parks is mainly one of interior space and geographical location. Prejudices against zoological gardens are mainly unfounded and based on an anthropomorphic approach. Lack of space is not a serious consideration. Animals are often healthier, happier and longer lived in zoological gardens. Wild animals trapped for zoological gardens are only a tiny fraction of those destroyed by various means. Importance of standard of maintenance of zoological gardens, whether the emphasis is on the recreational or the cultural side. Increasing scarcity of wild life demands attention from zoological gardens which provide the opportunity of rescuing species from extinction. Some species are now in urgent need of rescuing in this way. The additional indirect method of preserving wild life by the education derived from zoological gardens.

## 1. INTRODUCTION

The distinction between a zoological garden and a zoological park may be briefly summarised as follows : A zoological garden is usually a place where as large a number of the world's mammals, birds, reptiles, fish, etc., as possible are on show to the public in a small area, say 30 to 150 acres. These animals are usually kept in cages or restricted to small enclosures. The function of a zoological garden is to show animals to the public as conveniently as possible for their recreation and education, and to provide material for scientific study. A zoological garden is usually found in a large city.

A zoological park, on the other hand, is usually a place where a selection of the world's mammals, birds, etc., are maintained in an environment as far as possible similar to their natural habitat, in an area of some 300 to 600 acres or more. The animals are kept in open fields or small wooded glades or lakes ; and it is the human visitors who are restricted to fenced roadways and paths. It is situated usually outside, but not far from, a large city.

The chief difference, therefore, between a zoological garden and a zoological park is one of interior space and geographical location. The functions and the principles of management are generally similar for both these institutions, and for the purpose of this paper it is proposed to treat them together as one entity.

## 2. PREJUDICES SHOULD BE DISCARDED

There exists in the minds of many people, even of the widely-read and well-educated, a certain amount of prejudice against zoological gardens which may be roughly analysed as follows. They consider that conditions in captivity are detrimental to the happiness and well-being of animals due to lack of space and freedom. This idea is open to question, since it seems to be based entirely on an anthropomorphic approach to the subject. Certain people think that because they themselves enjoy seeing the wide open spaces the animals must react similarly.

It has recently been suggested by eminent biologists, naturalists and others who have studied animal behaviour that, contrary to the prevalent belief, most animals living in their wild state are confined to restricted territories, and that lack of space in captivity is probably not a serious consideration. As evidence of this is the fact that those species which range over the widest areas in their wild state, such as elephants, the larger hoofed mammals and birds of prey, are among the easiest to keep in confinement and usually live to a ripe old age. Birds in general often do better in small cages than in large aviaries.

If further examples are required, mention could be made of the male gorilla now in the London Zoo which is doing much better in its comparatively small cage than did the two pre-war gorillas in the very large house specially built for them. And there is the instance of the impala gazelles from Africa which never did well in a large enclosure at Whipsnade Park, but which have thrived and bred regularly after being transferred to a small pen in the Regent's Park Zoo in the heart of London.

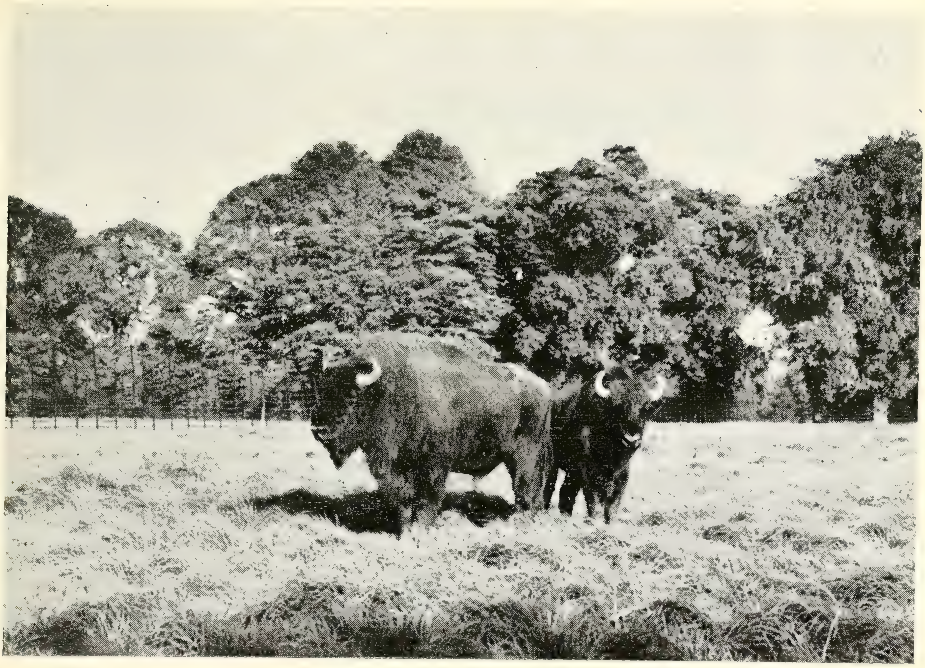
A further reason for a prejudice against zoological gardens in the minds of some people is the notion that animals are necessarily unhealthy when in captivity. But such people overlook the fact that the majority of animals are healthier, have a longer average life, and are better fed in good zoological gardens than in their wild state. Most of the animals which arrive in the London Zoo, for example, are infested with various parasites which have to be eliminated. The famous hunter F. C. Selous once stated that he could always distinguish the skin of a menagerie lion from that of a wild one because it was healthier and had a longer and glossier coat.

As for longevity Dr. Hindle (1950) has quoted the case of the Long-tailed Field Mouse, which in Britain seldom survives from one winter season to the next but in the London Zoo often lives for three or four years.

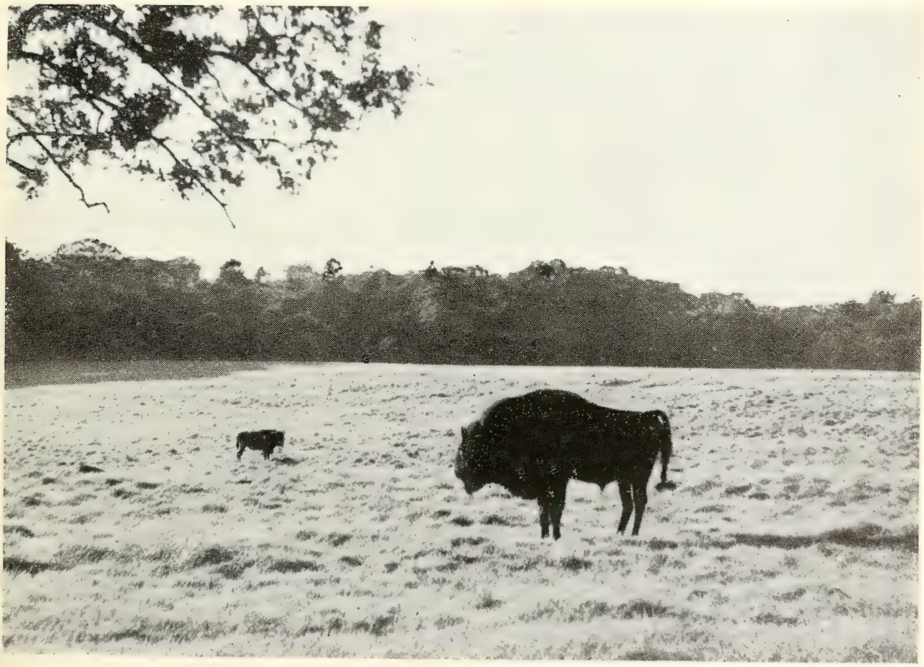
Another factor which leads many to suppose that wild animals are unhappy in zoological gardens is the ferocity and struggle they usually display when newly captured. It is well known, however, that this is due almost entirely to their fear of man : once this fear is removed, as quickly happens, the erstwhile wild creature settles down remarkably well and within an incredibly short time actually looks to its human captor for food and attention.

Wild elephants and rhinoceroses captured in India are outstanding examples of quickly losing their fear of man. Captured at all ages from one year to maturity, they exhibit a frightening savagery at first, but accept food from human hands within a few days and then can be contentedly ridden by a man after only a few weeks.

It has been observed in zoological gardens that a great many animals not only have no fear of human spectators but actually enjoy being watched by them. This is especially noticeable among apes, monkeys, bears, lions and seals—all of which greatly enjoy the presence of human visitors. As Dr. Hindle (1950) has observed, of the chimpanzees at the London Zoo there is always at least one individual which actually uses various devices to attract a crowd.



European Bison (Woburn Park, England)



American Bison (Woburn Park, England)
*(Photos: E. P. Gee)*

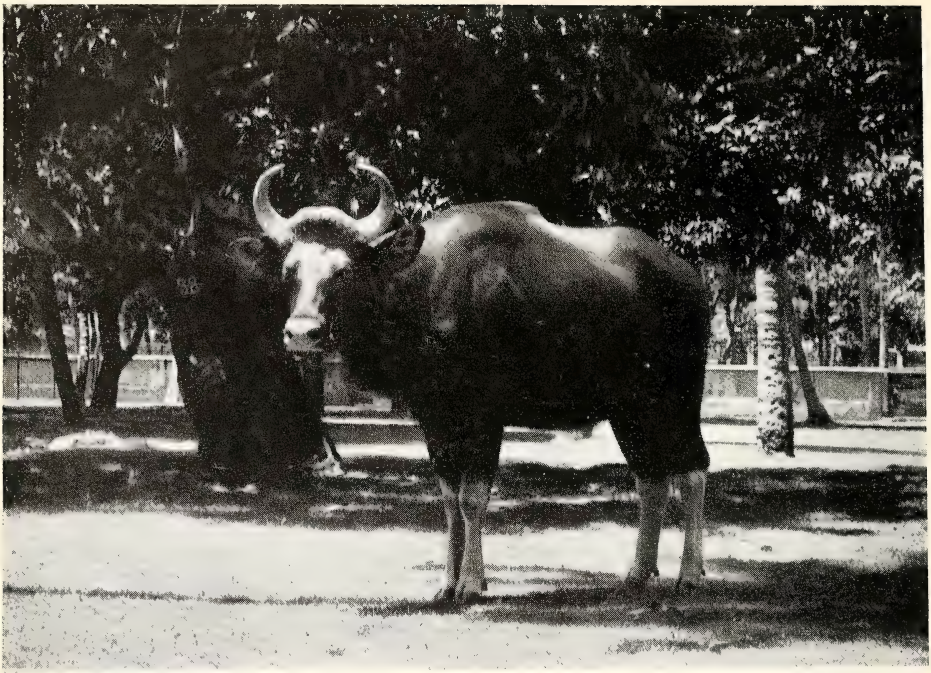
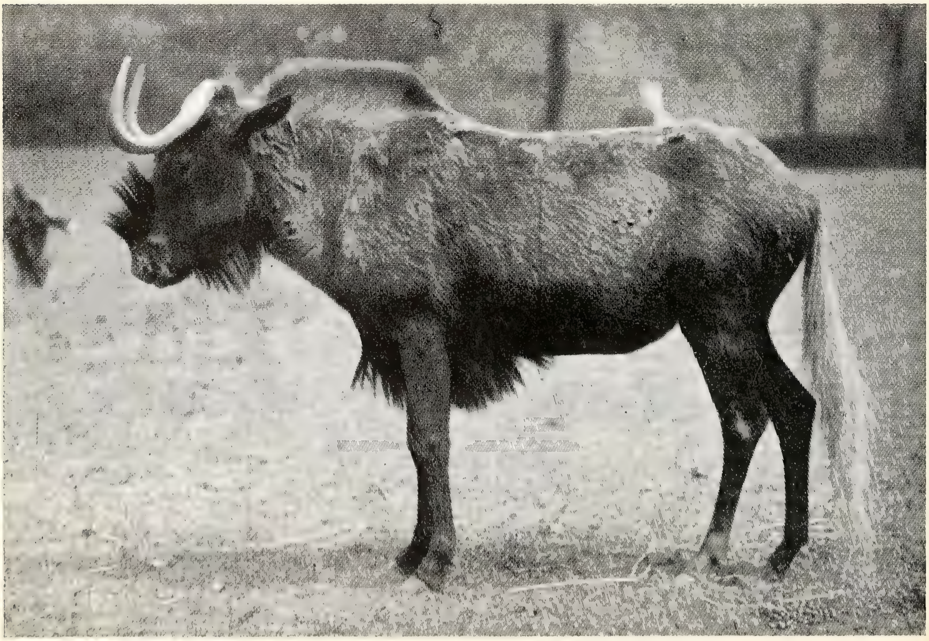


*Photo:* *E. P. Gee*

A bull Gaur, known to sportsmen in India as the 'Indian Bison', (Mysore Zoo)



*Courtesy:* *London Zoo*

White-tailed Gnu

It is sometimes thought that the keeping in captivity of wild animals brought from a cold climate into a hot one, or vice versa, is cruel. But wild animals, on the contrary, have rapid and remarkable powers of adaptation: the hippopotamuses from their hot river in Kenya have thrived and bred regularly in the cold, windy upland park at Whipsnade, and polar bears from the Arctic do well in gardens in a hot climate.

The training of animals in captivity is a more controversial subject. But if the animal being trained is in a healthy condition, and if it is not ill-treated in order to make it perform, then there would appear to be no harm done. Dr. Hediger (1950) claims that the training of animals in captivity can provide them with suitable occupation and the means of avoiding monotony and boredom. He believes that the training of animals probably provides them with a new interest, that it is therefore 'healthy, expedient and good' and that it can be regarded as corresponding to some extent with sport and athletic activities for civilized man.

A final aspect of zoological gardens which is apt to arouse some opposition among wild life conservationists is the alleged charge that the trapping of wild animals for the purposes of exhibition to the public constitutes a threat to the preservation of wild life. While this charge may be true in the case of certain rare and vanishing species, especially if captured in an unauthorised manner without due regard to their numbers and breeding seasons, it is not substantiated generally. It has been accepted by most persons qualified to give an opinion in the matter that the wild animals so captured alive for zoological gardens represent only a tiny fraction of the number killed in various ways, by destruction of their habitat, by overzealous sportsmen, by crop protectors, by poachers, and by commercial dealers in meat, ivory, fur, skins, etc.

It is obvious, of course, that any objectionable aspects connected with the live animal dealing business, such as cruelty and inadequate feeding and housing, should be severely dealt with by legislation.

## 3. Standards of Maintenance

It is generally accepted that the functions of zoological gardens are at the same time recreational and educational, or cultural. Zoological gardens vary considerably in standard of maintenance, from being purely menageries or amusement parks run merely for the recreation of the public on commercial lines for profit, to being institutions maintained primarily for cultural, educational and scientific purposes and only secondarily for recreation.

It has been pointed out by Mr. F. J. Appleman (1951) that for the purpose of classification 'It does not seem adequate to divide zoological gardens into cultural and non-cultural ones, as some non-cultural gardens are, thanks to their better financial position, much more up-to-date and better run and adapted than some poor so-called cultural zoos. The only right discrimination seems to be to divide the zoos into good and bad ones.'

Dr. A. L. Sunier (1952) believes that 'Zoological gardens, like museums, should have education as their first objective, and should be classified according to their efforts and their success or failure and not to their financial resources. Almost equal to their educational work is their important role in acting as scientific research centres . . . On the whole, the demand for living wild animals by zoological gardens is negligible as compared with other reasons for the disastrous diminution of many representatives of this type of fauna . . . Only zoological gardens worthy of the name which undertook the double task of education and scientific research should be allowed to acquire rare specimens.'

The general standard of maintenance, then, of a zoological garden as an institution of both educational and recreational value is the most important aspect, and the criterion by which it is to be judged. Of lesser importance is the actual size of the collection of animals exhibited: it is preferable to have fewer animals well maintained than a larger number less well maintained. It is better to have no zoological garden at all than to have one poorly maintained.

## 4. Need for Preservation of Wild Life

Having attempted to explain and remove the prejudice, real or imaginary, against zoological gardens, and to draw attention to the fact that the objectives should be primarily cultural and only secondarily recreational, it now remains to explain how such institutions can help specifically in the preservation of wild life.

With the huge increase of human population and agriculture throughout the world, and with the vastly improved means of destruction in the way of firearms, poisons and the like, wild life has diminished and is diminishing at an alarming rate. Two obvious methods of rescuing wild fauna from otherwise certain extermination are firstly national parks, nature reserves and wild life sanctuaries, and secondly zoological parks and zoological gardens.

The former method of large unspoilt areas is obviously the more desirable; but here lies a drawback that only a limited few of the world's human population can avail themselves of the opportunity of visiting such remote places, while zoological gardens are easily accessible in cities where there are great concentrations of people.

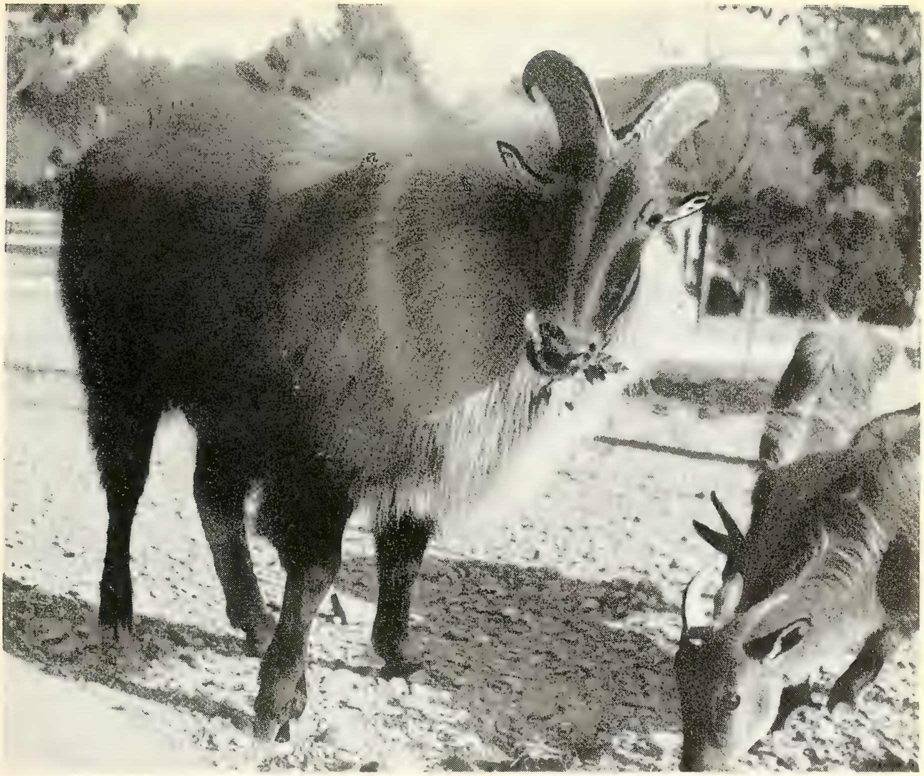
Dr. Rajendra Prasad, President of the Indian Republic, has wisely remarked that 'Whatever function the forest performs, the touchstone and measure of its value is human satisfaction.' Similarly it might be said that wild life and its preservation is not an end in itself: the measure of the value of wild life must ultimately be our own satisfaction.

It follows then that the more of the world's animals that can be humanely and attractively exhibited to the public for recreational and cultural purposes the better, provided that rare and vanishing species which are difficult to keep in captivity are excepted. It was for this reason that a few years ago the London Zoo wisely and humanely decided to discourage the further acquisition from the bamboo forests of western China of giant pandas, after the mysterious death of the ones in their garden, until more is known of their habits and food requirements.

Shortly after this the Chinese Government placed a total ban on the export of these creatures; and it is believed that there is none now in captivity unless behind the Iron Curtain.

It has been computed by Francis Harper (1945) that some 77 species of mammals alone have become extinct during the last 2,000 years, the rate of extinction having increased considerably during the last 150 years.

Many species of birds also have become extinct. When the Dodo was discovered in 1598 it was not realised that the future of a particular species was in danger, never to be replaced. It had become extinct by



*Courtesy:* *Basle Zoo*

Himalayan Tahr (Basle Zoo, Switzerland)

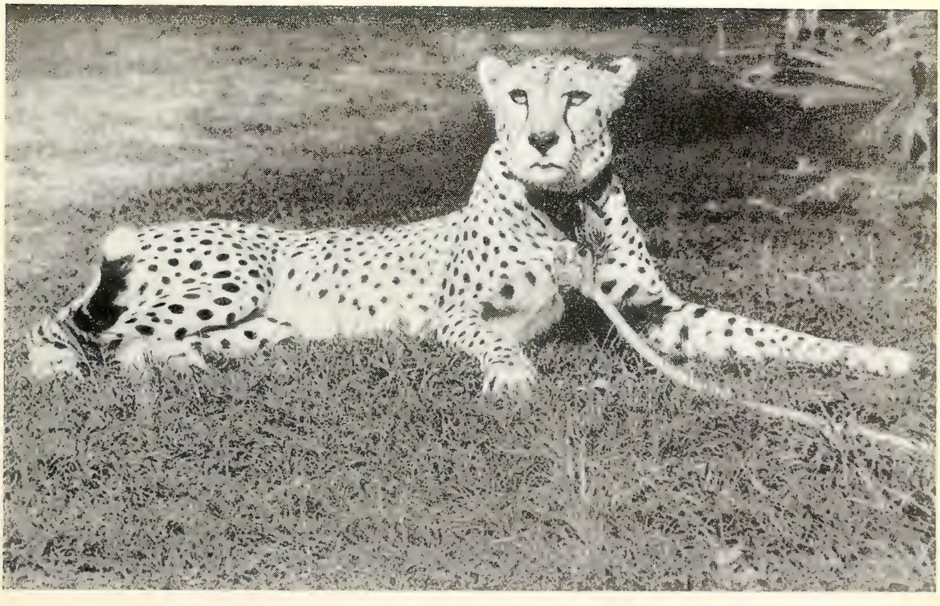


*Photo:* *E. P. Gee*

African Cheetah (Mysore Zoo)

*Photo:* *E. P. Gee*

'Extinct' Père David's Deer (Woburn Park, England)

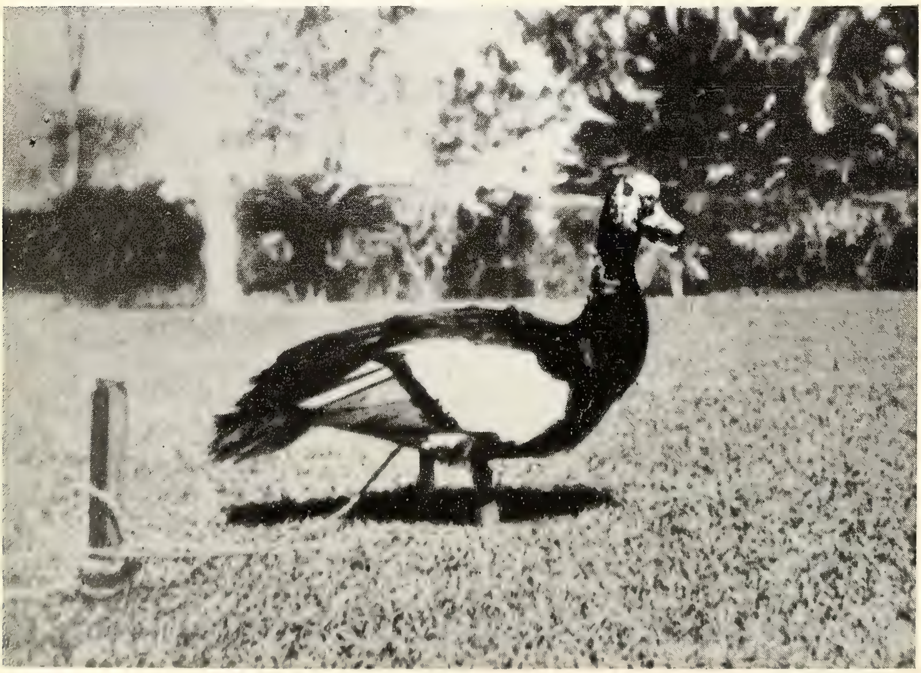


*Photo:* *V. C. Whyte*

Whitewinged Wood Duck in captivity

1681. From what is known of this flightless bird, it is possible that it could have been as easily preserved in captivity as it was impossible for it to survive in its wild state. The Labrador Duck and the Great Auk might also have been saved in zoological gardens.

The Passenger Pigeon, on the other hand, possessed the tendency to gregariousness to such a degree as to make it impossible to survive in any form of captivity, and the last of these birds died in the Cincinnati Zoological Park in 1914.

### 5. SOME SPECIES ALREADY SAVED

In comparatively recent years several species have been successfully saved from extinction by man in zoological gardens. The bison of America and of Europe have both been preserved in this way. The great herds of bison in America, popularly called ' buffalo ', which once roamed the western plains of the U.S.A. and which are estimated to have numbered fifty or sixty million head, are now extinct in their purely wild state. But a fair number of these animals are still living in a semi-domestic state in parks and zoological gardens throughout the world.

The European Bison is believed to be practically if not totally extinct in its wild state, but about ninety head are thriving in captivity in the parks and zoological gardens of the world.

The White-tailed Gnu of Africa, a much more interesting antelope than the Brindled Gnu of that continent, is also totally extinct in its wild state, but successfully preserved in certain farms, parks and gardens, where it now numbers about 1,000 head.

Perhaps the most ' classic ' example of a wild animal saved in captivity from extinction is the famous Père David's Deer. Formerly found in the swamps of Honan in China, then later confined to the Imperial Hunting Park south of Peking, the last female in China died in captivity in Peking in 1920. But a few had found their way to the zoological gardens of Europe; and in 1897 two or three animals in Woburn Park in England, home of the Dukes of Bedford, were the tiny nucleus of what is now a strong and vigorous herd of over 300. Deer from this renowned herd are now being sent to zoological gardens throughout the world, and could appropriately be re-introduced into their native haunts in China—if there was the will and the place to receive them.

A bird which has just been reported to have been saved by breeding in captivity is the Hawaiian Islands Goose. Sixteen of these birds are now thriving at the Severn Wildfowl Trust, and four goslings have recently been hatched out in Hawaii, itself bringing the total there to fourteen. Only thirty or forty wild birds now exist in the region.

Breeding in captivity has also been suggested as a means of saving the North American Whooping Crane, and attempts may be made to preserve this bird in a zoological garden in the near future.

### 6. SPECIES REQUIRING PRESERVATION

There are many species of mammals and birds which are now in urgent need of preservation in zoological gardens, since their existence is threatened in their native habitats. Of the three species of Asiatic rhinoceroses, all of which are rare and vanishing species, the Javan or Smaller One-horned is in the greatest danger. Not more than forty of these rare creatures are reported by A. Hoogerwerf (1954) to exist in their wild state in the Udjung Kulon Reserve of Java. Fortunate indeed will be the zoological garden which will be the first to obtain a pair of this rhinoceros, for at present no representative of this species exists in any zoological garden, although rhinoceroses generally do extremely well in captivity.

The Cheetah or Hunting Leopard is either extinct or practically extinct in its wild state as far as India is concerned; and it is imperative that any representatives of the Indian species still living in captivity should be carefully observed. It is most unfortunate that this animal is one of the very few creatures which have never bred in captivity in any part of the world, as far as is known.

Owing to its large size and the reduction of its habitat, the Great Indian Bustard is becoming extremely rare; and the possibility of rescuing this fine bird and preserving it in zoological gardens should not be overlooked.

The Whitewinged Wood Duck of north-east India, recently placed by the Indian Board for Wild Life on the list of birds proposed to be totally protected, is known to thrive in captivity: here is another opportunity of saving from extermination a species before it goes the way of the Pinkheaded Duck.

The Manipur sub-species of the Brow-antlered Deer, of which there are believed to be only a few representatives alive today, cannot possibly be expected to survive in their wild state. The only chance of successfully preserving them is in captivity where they do remarkably well. There is a fine herd of the Burma sub-species in the Rangoon Zoological Garden, and of the Indo-China sub-species in the Vincennes Zoological Garden of Paris.

Many other mammals and birds could be mentioned, which are now becoming rare and should therefore be safeguarded by some of their numbers being maintained in good zoological gardens in India and other countries.

## 7. CONCLUSION

There can be little doubt that well administered zoological gardens can be of the greatest direct value in preserving wild life by keeping and exhibiting rare and vanishing species.

There is, in addition, an indirect way: by education of the public, and by drawing their attention to the status of the species in their native haunts, public opinion will then be enlisted to the cause of wild life preservation.

With well-displayed legend information about the habits and habitat of each animal exhibited, and with simple but attractive maps showing former geographical range and present restricted distribution, and with further information available in the way of illustrated guide books, booklets, pamphlets, postcards and the like, much can be achieved in the field of education.

Visitors to a good zoological garden who can see animals in healthy and happy condition at close quarters in captivity can surely be led to visualise them in their natural surroundings. And if they cannot themselves go out into the remoter national parks and sanctuaries to see them in their wild state, at least they can determine that they will do all in their power to secure the survival of wild life for their own and for future generations.

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# BIONOMICS OF *URENTIUS ECHINUS* DIST. (HEMIPTERA—HETEROPTERA: TINGIDAE) AN IMPORTANT PEST OF BRINJAL (*SOLANUM MELONGENA* L.) IN NORTH GUJARAT[1]

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(*With two plates*)

## INTRODUCTION

Among the various vegetables grown in Gujarat, the brinjal crop (*Solanum melongena* L.) is prominently cultivated. However with its extensive cultivation the insect pests of brinjal have been noticed to regularly infest the crop and reduce its yield considerably almost annually. The most common insect pest of brinjal, particularly in the summer season, is *Urentius echinus* Dist. which occupies the first place in the extent and severity of damage. Therefore, investigations were undertaken with a view to obtaining fuller information on the life history and seasonal history of the insect.

### Incidence of the pest

The insect activity is mostly observed during the summer months between March and May. Weekly observations taken during this period showed that the peak of infestation is reached during April and May, when the summer crop is 3 to 4 weeks old, in the transplanted fields. However, the insect was also found breeding at a very low level on early planted monsoon crop as well.

### Technique of study

The insect population was estimated by counting the number of adults on three different sized leaves on the same plant. Observations made on ten random plants were averaged out and the insect population on a medium-sized leaf was estimated. Only the population of adult insects was taken each time. Investigations on the life-history of the insect were commenced in the laboratory on potted host seedlings. For this purpose nymphs of *U. echinus* Dist. obtained from the field were initially encaged

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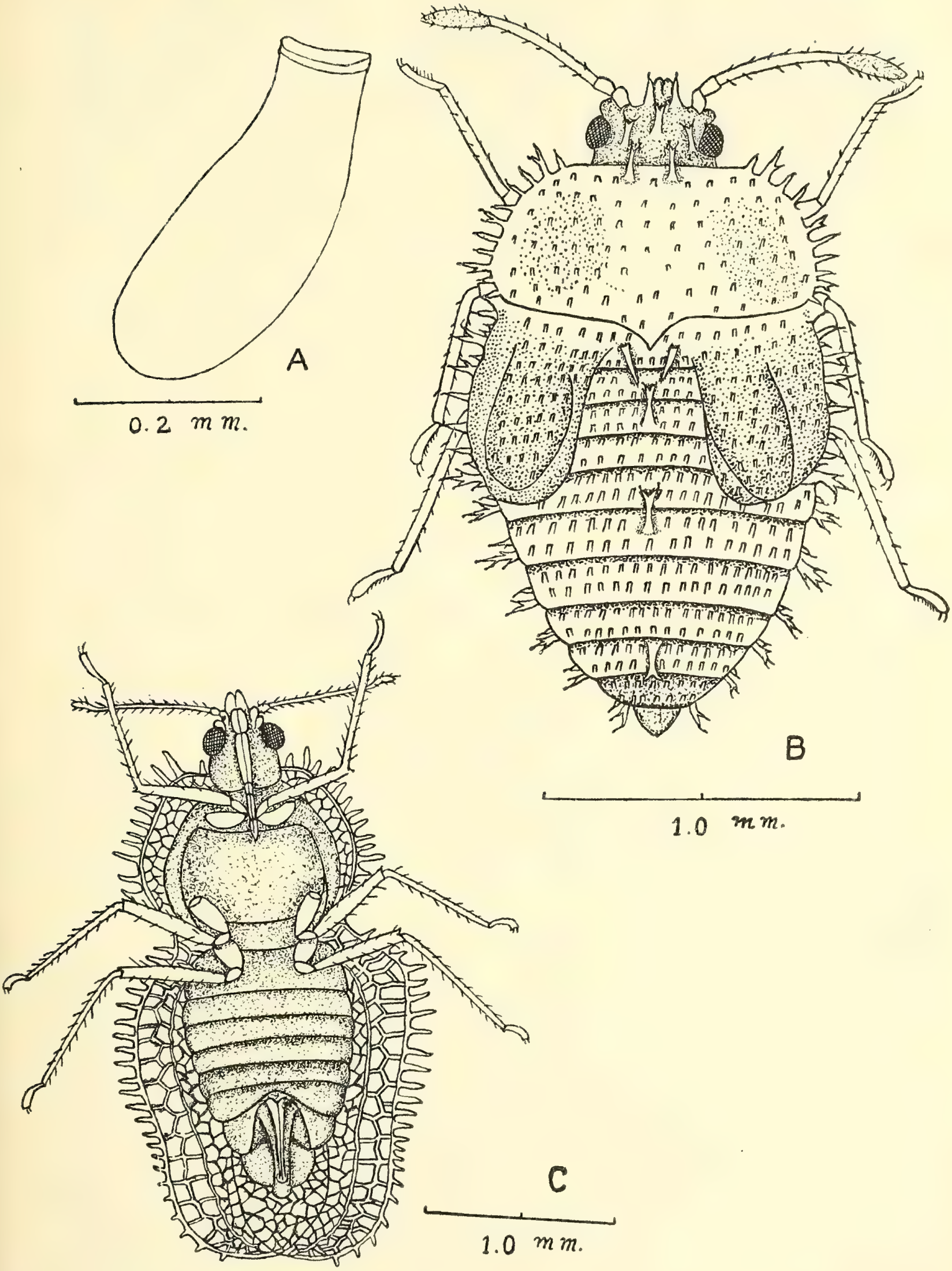
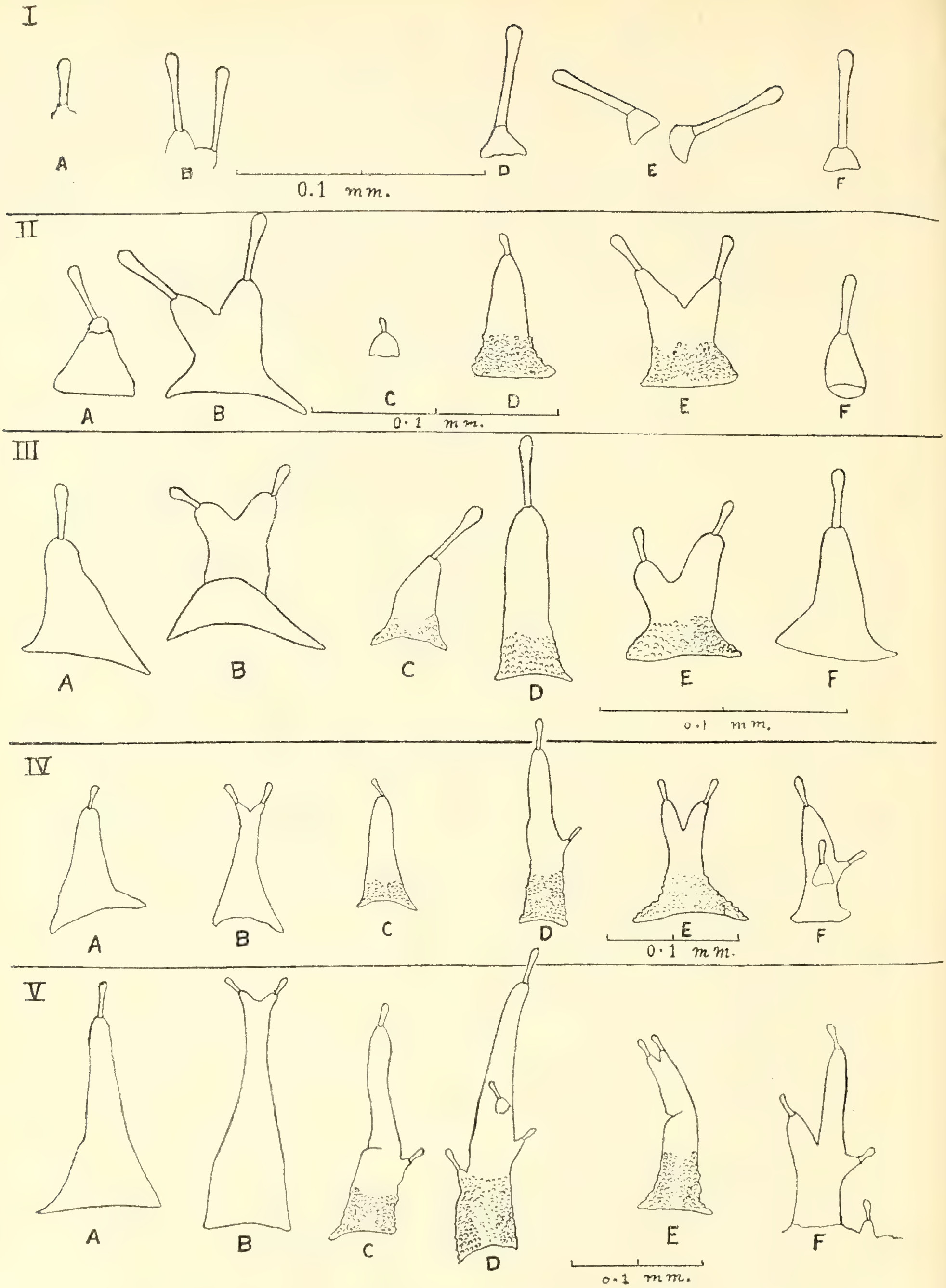
[1] Being a part of the thesis for the degree of M.Sc. (Agri.) submitted to the University of Gujarat by the former author under the guidance of the latter.


A
0.2 mm.
B
1.0 mm.
C
1.0 mm.

A — Egg of *Urentius echinus* Dist.
B — 5th instar nymph of *U. echinus* Dist.
C — Adult of *U. echinus* Dist.



Various tubercles or scoli on the nymphal instars of *U. echinus* Dist.

I. Elongated tubercles on the I instar nymph.

A. Elongated tubercle by the side of the base of the beak. B. Elongated tubercle on the mid-dorsal line above the base of the beak. D. Elongated tubercle on the mesothorax by the side of mid-dorsal line. E. Elongated tubercle on the first abdominal segment on the mid-dorsal line. F. Elongated tubercle on the third abdominal segment on the lateral side.

II. Scoli on the II instar nymph.
III. ,, III ,,
IV. ,, IV ,,
V. ,, V ,,

A. Scolus by the side of the base of the beak. B. Scolus by the mid-dorsal line above the base of the beak. C. Scolus on the anterior margin of the prothorax. D. Scolus on the mesothorax by the side of the mid-dorsal line. E. Scolus on the first abdominal segment on the mid-dorsal line. F. Scolus on the third abdominal segment on the lateral side.

in glass vials, reared up to adults, and the young ones obtained from them were used for further studies. The egg-laying capacity of individual insects was noted by pairing adults in glass tubes of convenient sizes. Small pieces of host leaves with wet cotton-wool plugs at the petioles were provided for the insects. Eggs laid in the leaves were counted under the stereoscopic microscope by receiving a strong beam of incident light on a concave mirror projected from below the infested leaf. The control of the insect in the field was tried with suitable insecticides during 1952.

### Historical Review

Study of *U. echinus* Dist. has been much neglected and practically no literature could be traced on the bionomics of this insect. Distant (1909) collected specimens from Ceylon and described the insect as *Urentius echinus.* From India, Lefroy and Howlett (1909) described the nature of damage caused by the insect and noted for the first time the habit of the insect of laying eggs in the leaf tissue. Subsequently *U. echinus* Dist. was reported from different Indian territories by Fletcher (1914, 1921), Pillai (1921), Ramakrishna Ayyar (1940) and Isaac (1933, 1946); while from Ceylon, by Henry (1916), Hutson (1921), Entomological staff (1923) and Jepson (1935) as damaging brinjal. Sinha (1951) reported the pest as of minor importance and stated that it is prevalent during latter part of the rainy season. He recommended DDT for the control of the pest without any experimental data.

### Nature of damage

Both nymphs and adults of *U. echinus* Dist. are responsible for damage to the host plants. The nymphs were mostly found to aggregate on the undersurface of the leaves, whereas the adults scattered mainly on the upper sides of the leaves. They sucked the cell sap by thrusting their proboscis into the leaf tissue. The damaged portions of the leaf developed characteristic whitish yellow patches and subsequently the leaves dried up. In case of heavy attack the plants turned sickly pale, suspended growth and finally dried out.

## LIFE HISTORY

### EGG. (Plate. 1, A)

Dull yellow with pale brownish operculum, measuring on an average 0·444 mm. in length and 0·174 mm. in width; slightly curved, wider in the middle with an oval operculum at the anterior pole and bluntly rounded posteriorly. The chorion of the egg is hard and without any surface patterns. The rim of the operculum showed inwardly projecting denticles. Generally the eggs were laid marginally inwards from the upper surface of the leaf, closer to each other. No eggs could be seen in the leaf veins. The eggs were thrust slanting in the leaf tissue with some glueing material in such a way that a little portion of the egg usually remained above the leaf surface.

### Incubation period of the egg

The incubation period of 52 eggs studied in the laboratory at temperatures ranging between 80·0°F. to 102°F. varied from 5 to 7 days with an average of 5·33 days during April and May. The data obtained is presented in the following table :

TABLE 1

Duration of the egg stage of *Urentius echinus* Dist.

| Season | Average temperature in °F. during the period of study | No. of eggs | Date of egg laying | Date of hatching of eggs | Incubation period of eggs in days | Average incubation period in days |
|---|---|---|---|---|---|---|
| May 1952 | 89·78 | 4 | 2-5-52 | 7-5-52 | 5 | |
| | | 5 | 2-5-52 | 7-5-52 | 5 | 5·11 |
| | | 1 | 2-5-52 | 9-5-52 | 7 | |
| | | 6 | 2-5-52 | 7-5-52 | 5 | |
| | | 2 | 2-5-52 | 7-5-52 | 5 | |
| April 1953 | 89·41 | 9 | 1-4-53 | 7-4-53 | 6 | |
| | | 11 | 5-4-53 | 10-4-53 | 5 | 5·44 |
| | | 8 | 6-4-53 | 11-4-53 | 5 | |
| | | 6 | 11-4-53 | 17-4-53 | 6 | |
| | | 52 | | | | 5·33 |

## THE NYMPH

### I INSTAR

Nymphs measured on an average 0·603 mm. in length and 0·267 mm. in width ; elongated oval and yellowish brown in colour. Dorsally the body is covered with 4 or less, small, white basiconic tubercles except on the head.

Head: Bears elongated tubercles each with an apical capitate spine (Plate 2, I). Two tubercles are placed just above the base of the beak, one on either side. A group of two similar tubercles originates posterior to the base of the beak on the mid-dorsal line. Two such pairs of similar tubercles are located on the inner aspect of the eyes, one on either side. *Eyes*: Composed of a group of five ommatidia, rose-red in colour. *Antennae*: 3 segmented, apically brownish, measuring on an average 0·199 mm. in length. Segments i and ii are subequal. Segment iii is the longest and shows a cleavage indicating the further line of division in the segment, to make up the full complement of the four segmented antenna. *Rostrum* : Three-segmented with brownish pointed tip, extends up to half the abdominal length.

Thorax: Prothorax without any raised dorsal tubercles. Laterally one marginal raised tubercle is present on either side. Mesothorax bears two tubercles with capitate apical spines, placed a little away from the mid-dorsal line, one on either side. Laterally it bears a marginal elongated tubercle, one on either side. The arrangement of tubercles on the metathorax is similar to that on the prothorax.

Abdomen: Each of the 1st, 4th and 7th abdominal terga bears a pair of elongated tubercles placed side by side along the mid-dorsal line, each having a capitate spine at the apex. Besides, all the abdominal segments bear a pair of tubercles with capitate apical spines, placed laterally, one on either side. The lateral tubercles on the 8th abdominal segment are placed posteriorly pointing backwards.

### II INSTAR

Nymphs yellowish brown with pale brown marginal patches on the thorax, measured on an average 0·826 mm. in length and 0·388 mm. in width. Dorsally, body covered over with 4 to 6 small, basiconic, white tubercles except on the head.

Head: Bears 5 elongated tubercles* each with an apical capitate spine (Plate 2, II). Two scoli are placed just above the base of the beak by the side of the mid-dorsal line. The two tubercles described in the first instar as arising side by side on the mid-dorsal line are fused basally, but yet distinctly separated apically. The two pairs of scoli each situated on the inner aspect of the compound eyes, also show similar fusion basally, but are bifurcated distally. *Eyes*: Brownish with 6–7 ommatidia. *Antennae*: 4 segmented with a brownish tip, measured on an average 0·280 mm. in length; segments i and ii subequal, segment iii is little longer than twice the length of segment i and segment iv is the longest. *Rostrum*:—3-segmented with a cleavage in the third segment; deep brown apically and extends upto the third coxae.

Thorax: The prothorax bears two very small unbranched scoli placed about the mid-dorsal line. Two pairs of similarly unbranched scoli are borne laterally, one pair on either side. Mesothorax bears two dark brown unbranched scoli, placed a little away from the mid-dorsal line, one on either side. The lateral scoli are similar in description to those on the prothorax. Metathorax bears only one unbranched scolus placed laterally on either side.

Abdomen: Each of the 1st, 4th and 7th abdominal terga bears a deep brown scolus on the mid-dorsal line, similar in shape to those situated near the inner aspect of the eyes. Laterally each of the abdominal segments bears an unbranched scolus, one on either side. The 8th abdominal segment bears lateral scoli projecting backwards from the posterior margin.

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* Such body structures are referred to as scoli by Kapur (1950). The description of the elongated tubercles referred to here compares well with the definition of scolus and therefore the tubercles are henceforth referred to as scoli.

### III INSTAR

Nymphs yellowish brown with greenish tinge measured on an average 1·008 mm. in length and 0·546 mm. in width; oval slightly flattened dorso-ventrally, with brown marginal patches on the thorax. Except the head, dorsally, each body segment bears 12 or less, small, white basiconic tubercles.

Head: All the five scoli on the head are similar to those of the II instar nymph in form and location (Plate 2, III). *Eyes*: Brownish, projecting outside with about 8 ommatidia. *Antennae*: 4 segmented, brown apically and measured on an average 0·364 mm. Segment ii is slightly longer than segment i and segment iii is the longest, nearly 3 times the segment i. *Rostrum*: 4-segmented with deep brown pointed tip extending upto the third coxae.

Thorax: The prothorax bears two unbranched elongated scoli, placed about the mid-dorsal line. In this instar, instead of one scolus as in second instar, there are 4 unbranched scoli of varying lengths placed laterally on either side. Mesothorax bears two dark brown unbranched scoli, one on either side, a little away from the mid-dorsal line. Four scoli of varying lengths are placed laterally on either side. Development of wing-pads is observed laterally, in the form of dark brown patches. Metathorax bears no scoli.

Abdomen: Each of the 1st, 4th and 7th abdominal terga bears a scolus, similar in structure to that described in the second instar. Lateral scoli on the third and fourth abdominal segments are brownish, while the rest are pale yellowish.

### IV INSTAR

Nymphs greenish yellow, mottled with brown to deep brown patterns, measured on an average 1·447 mm. in length and 0·84 mm. in width; oval, dorso-ventrally flattened, supressed anteriorly. Dorsally armoured with large number of small white basiconic tubercles except the head.

Head: The positions of the five scoli on the head remain the same as in the previous instars. The scoli by the side of the base of the beak are similar to those in the previous instar. Each of the remaining three scoli shows only slight bifurcation at the apex, with a short capitate apical spine (Plate 2, IV). *Eyes*: Deep brown projecting outwards with more than 8 ommatidia on either side. *Antennae*: Deep brown apically, 4 segmented measuring on an average 0·532 mm. in length. Segment ii is slightly longer than segment i, segment iii is the longest and slightly longer than three times the segment ii. *Rostrum*: Extends upto second coxae, 4 segmented showing a cleavage in the third segment indicating development of the 5th and final segment.

Thorax: Prothorax bears two unbranched slightly elongated scoli placed about the mid-dorsal line. Laterally it bears 6 to 8 scoli on either side. Mesothorax bears two dark brown unbranched scoli placed little away from the mid-dorsal line, one on either side. On the stem of each of these scoli one to three minute tubercles bearing small spines are visible. Lateral scoli are similar to those present on the prothorax. Wing-pads are well marked extending upto half the first abdominal segment. The lateral scoli on the mesothorax appear to have been reduced.

Abdomen: Each of the 1st, 4th and 7th abdominal terga bears one deep brown scolus placed on the mid-dorsal line showing slight bifurcation at the apex. The basal part of the scolus is elongated with one or two minute spined tubercles on the stem. The lateral scoli also bear similar minute spined tubercles on their basal parts.

V INSTAR. (Text-fig. 1, B)

Nymphs greenish yellow, mottled with deep brown to black patterns, measured on an average 2·114 mm. in length and 1·204 mm. in width; oval, but slightly supressed anteriorly and flattened dorso-ventrally, armoured with numerous small, white basiconic tubercles all over the body except the head.

Head: The two elongated scoli placed by the side of the base of the beak are further elongated. The remaining three scoli, indicating only slight bifurcation apically, are armoured with none to two spined tubercles on the stem. Their positions are the same as described in the previous instar. (Plate 2, V). *Eyes*: Deep brown, distinctly projecting outwardly. *Antennae*: 4 segmented, measuring on an average 0·757 mm. in length, deep brown apically. Segment i is slightly longer than segment ii and is about one-fourth segment iii; segment iii is the longest and is little more than one and half times the segment iv. *Rostrum*: 5-segmented but the cleavage in the third segment is yet indistinct; deep brown pointed, highly sclerotised and extends upto the posterior margin of mesothorax.

Thorax: Prothorax bears two unbranched scoli placed about the mid-dorsal line, bearing one or two spined tubercles on the stem. Laterally about 9 to 10 brown scoli are borne on either side. Mesothorax bears two deep brown scoli placed a little away from the mid-dorsal line with 2 to 3 minute spined tubercles on the stem of either. Lateral scoli are similar to those on the prothorax. Wing-pads are deep brown distally, extending as far back as the 3rd abdominal segment.

Abdomen: Each of the 1st, 4th and 7th abdominal terga bears one deep brown scolus placed on the mid-dorsal line, showing slight bifurcation apically and armoured with one or two minute spined tubercles on the stem. First two abdominal segments bear no lateral scoli, whereas the rest of the abdominal segments laterally bear one scolus with one to three minute spined tubercles borne on the stem and an additional spined tubercle placed anterior to the scolus itself.

Duration of the nymphal period: The nymphal period varied from 7 to 9 days during the months of April and May 1952 and 1953, when the laboratory temperatures varied from 80·0°F. to 104·0°F. The nymphs moulted 5 times to reach the adult stage. The data pertaining to the average duration of the nymphal instars is given below :—

TABLE 2

Duration of the nymphal instars of *Urentius echinus* Dist.

| Season | Average temperature in °F. during the period of study | No. of individuals | Average duration of the stadium in days | | | | | Average duration of nymphal period in days |
|---|---|---|---|---|---|---|---|---|
| | | | I | II | III | IV | V | |
| May 1952 ... | 90·05 | 7 | 1·86 | 1·43 | 1·43 | 1·29 | 2·14 | 8·15 |
| April 1953 ... | 90·68 | 9 | 2·00 | 1·00 | 1·00 | 1·89 | 2·22 | 8·11 |
| April 1953 ... | 90·39 | 8 | 2·00 | 1·50 | 1·25 | 1·25 | 2·125 | 8·125 |
| Average ... | ... | 24 | 1·96 | 1·29 | 1·21 | 1·50 | 2·17 | 8·13 |

It will be seen that the duration of the I and V instars is 1·96 and 2·17 days respectively, which is longer than that of the remaining instars. The nymphal period in the II, III and IV instars is not more than one and a half days. The average duration of the total nymphal period comes to 8·13 days.

THE ADULT. (Plate 1, C)

The adult measured on an average 2·367 mm. in length and 0·922 mm. in width, with blackish brown body. Female measured on an average 0·066 mm. shorter and 0·08 mm. wider than the male.

Head: The positions of the scoli on the head remain the same. The scolus borne on the mid-dorsal line shows very little or no bifurcation at the apex but bears two short spines only. The scoli by the side of the compound eyes do not indicate any bifurcation and are without apical spines. *Eyes*: Corinthian red, projecting laterally, occupying about two-fifths of the head width. *Antennae*: 4 segmented, brownish black apically, measuring on an average 0·906 mm. in length. Segments i and ii are bulb-like, segment iii long and slender and segment iv is club shaped and placed at an angle. Segment ii is little less than one and a half times segment i, and segment iii is about nine times the segment i and little more, than two and half times the segment iv. *Rostrum*: Measured on an average 0·718 mm. in length, 5 segmented, honey-dew in colour except the last segment which is brownish black. Laterally it is guarded by a pair of marginally spined areolated buculae.

Thorax: Prothorax dorsally bears a triangular areolated shield with long scoli on the anterior margin. Anteriorly it covers some portion of the head and its posterior apex extends as far back as the 5th abdominal segment. Mesothorax and metathorax are small and do not bear any tubercles or scoli on the surface. *Wings*: The forewing is rectangular completely areolated and armoured with spines on the costal margin and the veins. At the base of the forewing, proximal to vannus, a well-developed elongated areolated lobe is present, which is comparable to the jugum. The hindwing is membraneous and does not present any areolations.

Abdomen: Slightly concave dorsally and convex ventrally without any spines or scoli. Last three segments bear a number of minute marginal hairs.

Sex differentiation: The sex of the adults could be judged from the external genital organs. In female the tip of the abdomen is bluntly rounded and the 7th abdominal sternum bears the ovipositor which extends up to the tip of the abdomen. In male the last abdominal segment is rectangular with rounded posterior margin bearing two inwardly-bending sickle shaped claspers.

Longevity and fecundity of adults: For the study of egg-laying capacity of an individual female, the insects were bred in glass vials during April and May 1953, at temperatures varying from 80·0°F to 104·0°F. (Table 3).

TABLE 3

The egg-laying capacity and the pre- and post-oviposition periods of *U. echinus* Dist.

| No. of observation | No. of pairs | Pre-oviposition period in days | Oviposition period in days | No. of eggs per female | Post oviposition period in days | Total life in days | |
|---|---|---|---|---|---|---|---|
| | | | | | | Male | Female |
| 1 | 1 | 2 | 11 | 62 | 0 | 9 | 13 |
| 2 | 1 | 3 | 10 | 108 | 0 | 4 | 13 |
| 3 | 1 | 3 | 2 | 22 | 0 | 4 | 4 |
| 4 | 1 | 2 | 13 | 120 | 0 | 4 | 15 |
| 5 | 1 | 3 | 5 | 40 | 0 | 5 | 8 |
| 6 | 1 | 3 | 6 | 30 | 0 | 9 | 9 |
| 7 | 1 | 3 | 3 | 13 | 0 | 6 | 5 |
| 8 | 1 | 3 | 1 | 4 | 1 | 6 | 5 |
| 9 | 1 | 2 | 13 | 142 | 0 | 15 | 15 |
| 10 | 1 | 2 | 9 | 108 | 0 | 9 | 10 |
| 11 | 1 | 3 | 11 | 165 | 1 | 15 | 15 |
| Average ... | ... | 2·64 | 7·64 | 74·0 | 0·18 | 7·81 | 10.18 |

It will be seen that the pre-oviposition period of females varied from 2 to 3 days with an average of 2·64 days, whereas the oviposition period varied from 1 to 13 days with an average of 7·64 days. In the majority of cases the females died just after oviposition, and thus the post-oviposition period averaged as low as 0·18 days. The number of eggs laid by a single female varied from 4 to 165 with an average of 74·0 eggs per female. In two trials arranged during April and May 1953, wherein 4 and 5 pairs were caged together, an average of 62·5 and 92·0 eggs were laid per female respectively. The longevity of male and female bugs varied from 4 to 15 days with an average of 7·81 and 10·18 days respectively. Out of two pairs reared in the laboratory, during December 1953, when the temperatures varied from 60·0°F. to 89·0°F., the females survived for 29 and 33 days while the males survived for 16 and 18 days respectively.

From the laboratory rearings it was observed that the females of *Urentius echinus* Dist. regularly preferred to oviposit only on the upper surface of the host leaf. An experiment was therefore arranged to study the selection of the host leaf areas by the insects for egg-laying. For this purpose 12 pairs of bugs were enclosed in a glass bowl with a fresh healthy brinjal leaf. After 48 hours the leaf was taken out and circumscribed in three approximately equal zones—one in the centre of the leaf, another towards the margin, and the third between the two. It was found that the outermost zone of 0·5 cm. width contained 123 eggs, the middle zone of 0·6 cm. in width contained 70 eggs and the innermost zone contained only 40 eggs. Out of 233 eggs laid by the females, only two eggs were observed to have been laid on the under-surface of the leaf. It could be inferred from these observations that the bugs selected the marginal areas of the upper surface of the leaves for oviposition.

## CONTROL MEASURES

Fletcher (1914, 1921) recommended spraying with crude oil emulsion and picking off affected leaves. Gurcharan Singh (1945) attempted 0·5 to 4% DDT dusts with cow-dung-ash as carrier on potted plants. He found that the bugs died in 24 hours. Sinha (1951) suggested 3% DDT dust or spray against *U. echinus* Dist. but without any experimental data. Workers in the past have recommended the use of DDT to control the pest without any experimental data. It was therefore thought worthwhile to plan an experiment on a field scale to study the effect of DDT as an insecticide to control the pest. The following insecticidal treatments were included in the experiment :—

A – Control.
B – 0·1% DDT water suspension + Nicotine sulphate (1 part of 40% Nicotine in 960 parts of water).
C – 0·2% DDT water suspension spray.
D – 0·3% DDT water suspension spray.

The DDT sprays were formulated using 'Guesarol 550' a 50% DDT water wettable powder.

The treatments were replicated 4 times and laid out in a randomised block. It covered an area of 18,262 sq. ft. The results obtained have been tabulated in Table 4.

TABLE 4

Average population of *Urentius echinus* Dist. before and after treatments with DDT concentrations

| No. of application | Time of observation | Average No. of adults per medium-sized leaf | | | |
|---|---|---|---|---|---|
| | | A | B | C | D |
| 1 | Initial ... | 4·36 | 4·13 | 3·60 | 4·19 |
| | 24 hours after treatment ... | 3·82 | 1·83 | 1·02 | 0·96 |
| | 48 hours ,, ,, .. | 3·92 | 1·80 | 1·65 | 1·72 |
| | 1 week ,, ,, ... | 4·08 | 0·48 | 0·27 | 0·40 |
| | 2 weeks ,, ,, ... | 3·11 | 0·70 | 0·46 | 0·77 |
| 2 | 24 hours ,, ,, ... | 3·93 | 0·40 | 0·23 | 0·22 |
| | 48 hours ,, ,, ... | 2·45 | 0·44 | 0·23 | 0·13 |
| | 1 week ,, ,, ... | 1·06 | 0·33 | 0·19 | 0·13 |
| | 2 weeks ,, ,, ... | 1·18 | 0·33 | 0·19 | 0·22 |

It will be seen that each of 0·1% DDT with nicotine sulphate, 0·2% DDT and 0·3% DDT proved effective in the control of the pest. However, between the treatments no significant difference was noticeable. The gradual decline in the population of the insect in the control plots may be due to the highly devitalised leaves and reduced number of plants to sustain insect population. After 16 days from the treatment, the control plots showed only 20% of the plant population as compared to 85% in the treated ones. On working out the economics of these treatments it was found that 0·2% DDT spray was the most economical and effective in the control of the pest.

## SUMMARY

*Urentius echinus* Dist. is one of the important insect pests of brinjals in North Gujarat, so much so that on the summer brinjal crop the insect behaves as a limiting factor in the successful cultivation of the crop. The insect is mostly noticed during February to May. On an average a female laid 74·0 eggs. However, the maximum egg-laying capacity is 165 eggs. The incubation period of eggs varied from 5 to 7 days with an average of 5·33 days when the laboratory temperature ranged from 80·0°F. to 102·0°F. The nymphs passed through five instars to reach the adult stage. The nymphal period varied from 7 to 9 days with an average of 8·13 days when the laboratory temperatures varied from 80-0°F. to 104·0°F. The pilot trial conducted to control the pest in the field indicated that 0·2% DDT water suspension spray is effective and economic for recommendation to the cultivators.

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# SOME NOTES ON THE RICE GALL-FLY, *PACHIDIPLOSIS ORYZAE* (W.-M.)

BY

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## INTRODUCTION

Rice is the most important crop in the Nizamabad District of Hyderabad State, the annual acreage under the crop being 2,20,000 acres. The crop is cultivated in two seasons, viz., *Abi* and *Tabi.* *Abi* is the monsoon crop where the sowings are done during June and July and harvested in the months of November and December. *Tabi* crop is sown in January and February and harvested in the months of April and May. The *Abi* crop is of longer duration and is almost invariably transplanted, whereas the *Tabi* crop is generally broadcast sown. The average rainfall of the tract is 40″, received mostly in south-west monsoon months.

## RICE GALL-FLY IN NIZAMABAD AREA

Rice Gall-fly, *Pachidiplosis oryzae* (Wood-Mason), popularly known as ‘ Koyya ’ and ‘ Koyya dumpa ’, used to be a comparatively minor pest in Nizamabad till 1947. In September 1947, however, there was a severe outbreak of the pest on a large scale and a random survey conducted revealed that nearly 30% of the area under the crop was affected. Since that time investigations are being carried out on the biology and control of this pest, and some of the observations recorded are presented in this paper.

## SEASONAL HISTORY

The Gall-fly unlike most of the other rice insect pests in the Nizamabad area is not observed on both the seasonal crops in a pest form but is almost exclusively noted in *Abi* season only. As noted, the *Abi* seasonal crop is sown in the months of June-July. The first appearance of the insect on the crop differs only slightly from season to season, as shown in the table below. The second week of July appears to be the normal period of the first appearance of the pest.

TABLE I

The period of first appearance of Rice Gall-fly on Abi paddy, during different years

| *Year* | | *Period of first appearance* |
|---|---|---|
| 1948 | ... | July 2nd week. |
| 1949 | ... | June last week. |
| 1950 | ... | July 1st week. |
| 1951 | ... | July 1st week. |
| 1952 | ... | July 2nd week. |
| 1953 | ... | August 1st week. |
| 1954 | ... | July 1st week |

After its first appearance in the second week of July, galls are observed in stray numbers only till middle of August. From there on the incidence of the pest rises very high. Innumerable galls are observed in the crop by this time. This is the first ' peak ' of the incidence of the pest as noted by both the numbers of galls in the field as well as catches of the adults at the light. According to the season, this appearance of the ' peak ' may vary a week to ten days earlier or later. There will be a break of a fortnight to 20 days before the second ' peak ' in incidence is observed. The damage done at this time is mostly to late secondary tillers and tertiaries. The maggots of this ' peak ' or generation are very heavily parasitized by *Platygaster oryzae* C. (Hymenoptera). The attack of the pest dwindles down from the first week of October. Stray galls continue to be observed, however, throughout October. It has not been possible to clearly mark out the broods as there is great overlapping of generations. Adults are short lived (3–5 days).

Soon after the harvest of the short duration crop, the stubble germinated crop will also be sometimes found attacked. In the *Tabi* season, though the midge is not observed in pest form, stray galls are observed in the crop.

## INCIDENCE IN RELATION TO TIME OF SOWING

It has been a common observation amongst workers that late sown crops become susceptible to gall-fly attack. It is reported that damage is insignificant when operations are carried out early and the plants grow to some height (Proc. 3rd Ento. Meeting, Pusa.). Ramchandra Rao (1926) mentions that during 1925, when there was a severe outbreak of this pest at Buntawal in South Canara, the early-planted fields were only lightly attacked, while those planted a fortnight later suffered very badly. The earliest possible sowing or transplanting is recommended by Hegdekatti (1927) as a measure of control against the Rice Gall-fly.

During 1952–53 *Abi* season, observations were recorded at the Agricultural Research Station Rudroor on the incidence of Gall-fly in six numbers of weekly sowings commencing from the last week of June 1952. The variety planted was H.R. 19, a common rice variety grown in the Nizamsagar tract. The data recorded are given in the table below :—

TABLE II

The incidence of Gall-fly on the variety H.R. 19 in different weekly sowings

| *Date of transplanting* | | *Total number of Galls observed in eight 3′ × 3′ units* |
|---|---|---|
| 1. 28-6-1952 | ... | 15 |
| 2. 5-7-1952 | ... | 28 |
| 3. 12-7-1952 | ... | 28 |
| 4. 19-7-1952 | ... | 21 |
| 5. 26-7-1952 | ... | 83 |
| 6. 2-8-1952 | ... | 79 |

The late transplantings, especially those done in the last week of July and first week of August, have recorded a higher incidence.

The data recorded at Government Experimental Farm, Yedpally, on the incidence of Gall-fly in 1950 on the variety H.R. 19 transplanted side by side on two different dates are also given below :—

TABLE III

The incidence of Rice Gall-fly on the variety H.R. 19 sown on two different dates

| *Plot No.* | *No. of Galls observed in two 3′ × 3′ units in crop transplanted on* 11-7-1950 | 24-7-1950 |
|---|---|---|
| 1 | 1 | 14 |
| 2 | — | 6 |
| 3 | 3 | 8 |
| 4 | — | 10 |
| Mean | 1·0 | 9·5 |

The data obtained from routine field survey have also confirmed that broadcasting or transplanting of the crop after the last week of July renders it susceptible to Gall-fly attack.

### RELATION TO SOME OF THE RICE VARIETIES

It has been observed that Gall-fly has a greater preference for certain rice varieties. During 1950–51 and 1951–52 *Abi* seasons, observations were taken in the District Trial Plots meant for comparison of new varieties of rice. The percentage incidence of Gall-fly observed in the different rice varieties in some of the taluquas of the Nizamabad district is given below :

TABLE IV

Incidence of Rice Gall-fly in some varieties of rice in Nizamabad District

| | *% incidence in Rice varieties* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Abi* 1950–51 *season* | | | | | | | |
| *Locality* | HR 12 | HR 17 | HR 14 | HR 55 | HR 38 | HR 67 | HR 71 | HR 47 |
| Armoor ... | — | 14·6 | 14·1 | 17·6 | | | | |
| Banswada ... | 11·2 | 7·3 | 4·7 | 7·2 | | | | |
| Nizamabad ... | | | 6·4 | | | 6·6 | 9·8 | 7·6 |
| | *Abi* 1951–52 *Season* | | | | | | | |
| Armoor ... | | 2·8 | 3·1 | 2·9 | | | | |
| Banswada ... | 10·2 | 7·6 | 4·9 | 6·5 | | | | |
| Nizamabad ... | | | 7·5 | | | 13·7 | 8·8 | 9·5 |

Of all the varieties, the variety H.R. 14 has consistently recorded low incidence.

During the year 1952–53, *Abi* season, observations were conducted in a varietal test with the following six varieties, viz. Teksannal, H.R. 8 H.R. 19, H.R. 21, H.R. 22 and H.R. 33 replicated five times. The crop had been broadcast sown on 1-8-1952. The incidence of Gall-fly recorded on three different dates is given below :

TABLE V

Showing the Gall-fly incidence in different Rice varieties during 1952-53 *Abi* season

PROGRESSIVE

| *Variety* | | *Percentage incidence recorded on* 8-9-1952 | 23-9-1952 | 10-10-1952 |
|---|---|---|---|---|
| 1. Tekksanal | ... | 3·6 | 6·6 | 15·4 |
| 2. H.R. 8 | ... | 5·5 | 16·9 | 28·7 |
| 3. H.R. 19 | ... | 3·4 | 7·1 | 8·4 |
| 4. H.R. 21 | ... | 5·9 | 9·0 | 13·5 |
| 5. H.R. 22 | ... | 3·7 | 11·4 | 12·9 |
| 6. H.R. 33 | ... | 3·6 | 6·7 | 11·4 |

The variety H.R. 8, which is a selection from an indigenous variety *Gandhari Nikko* is found to be comparatively more susceptible to the attack of Gall-fly. The sheath of this variety is of purple colour in contrast to the green colour of the other varieties under test. This observation is contrary to that of the observations recorded at the Central Rice Research Institute, Cuttack (1952).

## NATURAL ENEMIES

*Platygaster oryzae C.* (Hymenoptera) a larval parasite is the only natural enemy of the Rice Gall-fly so far recorded in this tract. Its appearance is rather late in the season, and without further work its usefulness cannot be estimated. The percentage of parasitization at various periods of the *Abi* season recorded in 1952 is given below :—

TABLE VI

Showing the percentage parasitization of Rice Gall-fly Maggots by *Platygaster oryzae* C.

| *Date of observation* | *Locality* | *Parasitization percentage* |
|---|---|---|
| 23-7-1952 | Rudroor | Nil |
| 28-7-1952 | Bodhan | Nil |
| 15-8-1952 | Rudroor | Nil |
| 19-8-1952 | Rudroor | Nil |
| 20-8-1952 | Bodhan | 5·0 |
| 27-8-1952 | Bodhan | 76·8 |
| 29-8-1952 | Rudroor | 15·3 |
| 3-9-1952 | Rudroor | 100·0 |

## LIGHT TRAP EXPERIMENTS

One of the known control measures against the Rice Gall-fly is the setting up of light traps, although its efficacy has been doubted sometimes (Proc. 3rd Ento. Meeting, Pusa). Sen (1953) however records that the population of the midge was reduced considerably by setting up light traps for 5 consecutive nights at one place. Under the direct guidance and direction of the Senior author, who is also the Plant Protection Officer to the Government of Hyderabad, petromax light traps were arranged during the years 1953-54 and 1954-55 *Abi* seasons in Banswada taluqa of

Nizamabad district. Three places were selected for keeping the traps, namely Borlum, Banswada proper, and Durki. Fifteen petromax lanterns were assigned to each place, each petromax to cover an area of 30 acres. The traps were kept at each locality for a period of 10 weeks commencing from the 4th week of July 1953 during 1952–53 season and from 3rd week of July 1954 during 1953–54 season. The catches during the 1st two weeks in 1952–53 season were almost nil. The maximum number of adult Gall-flies were attracted to the traps during the period commencing from last week of August to second week of September and again during the first week of October in all the places. The total number of flies that were caught at Banswada proper were 17,139 during 1952–53 season and 1,01,510 during 1953–54 season. The average numbers of traps kept at this place were ten.

At the time of harvest of the crop during 1952–53 season, a number of random $3' \times 3'$ units were located in all the three places in areas served by the light traps (Treated) and those not served (Control). For comparison, care was taken to see that both experimental and control crops were fairly similar as regards the time of sowing, manurial treatments, cultivation, etc. The varieties selected for the comparison were the same. The average numbers of matured earheads at harvest in $3' \times 3'$ units in both treated as well as control areas are given in the table below, which indicates the efficacy of the traps.

TABLE VII

Average number of matured ears in areas served by light traps and those not served

| *Locality* | *Variety* | *Total No. of 3′ × 3′ units* | *Average Nos. of Matured ears in Treated area (3′ × 3′ unit)* | *Average Nos. of Matured ears in Control area (3′ × 3′ unit)* |
|---|---|---|---|---|
| Banswada ... | H.R. 35 | 10 | 199 | 169 |
| Durki ... | H.R. 35 | 36 | 217 | 134 |
| Durki ... | R.D.R. 4 | 24 | 159 | 102 |
| Borlum ... | H.R. 35 | 48 | 198 | 112 |

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## SUMMARY

*Pachidiplosis oryzae* (Wood-Mason) Mani—the ceycidomyiid midge is one of the major insect pests of rice in the areas served by the Nizamsagar Reservoir in the Hyderabad State. Unlike other rice insect pests in the area, it is only observed in pest form in the *Abi* seasonal crop sown in June-July. Its active period extends from 2nd week of July to end of September. The rice crop sown late after last week of July is found highly susceptible to this pest. Amongst the varieties, H.R. 14 has

consistently recorded low incidence of this pest, whereas H.R. 8, a purple sheathed variety, fairly higher incidence. The Proctotrypid parasite—*Platygaster oryzae* C. is the only natural enemy of the pest observed in the area. The setting up of the light traps is found to give a good measure of control of this Gall-midge.

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# WILD LIFE PRESERVATION IN INDIA

## Annual Report for 1953 on the Southern Region

BY

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*Regional Secretary*

### Wild Life in the Region

In this report no attempt is made to give a comprehensive survey of the varied wild life in the Southern Region—viz. Madras, Mysore, Hyderabad, Travancore-Cochin, Coorg, Andhra and the Andamans—as that would be needless repetition of what is now available in the *Fauna of British India* volumes, and similar books. I have confined myself to the mention of certain species in this region that are urgently in need of the strictest protection, and more particularly to certain problems of wild life protection in India.

The Great Indian Bustard, the Hunting Leopard, the Nilgiri Tahr and the Nilgiri Black Langur, and perhaps the Malabar Squirrel, are good examples of species more or less threatened with extinction; in some of these the threat has gone a long way towards fulfilment. However, I think that certain other animals, not so patently threatened, are no less in need of protection. It is wise to act on the basis that prevention is better than cure in the matter of wild life conservation, especially as we are not now in a position to fully realize or completely control the factors that lead to the decline and disappearance of our fauna. Hence, I would certainly include such animals as the Four-horned Antelope, the Chinkara, and the Blackbuck in any list of beasts specially in need of protection in the Southern Region.

It is well known that the Four-horned Antelope is capricious in its distribution and that this unique beast is peculiar to India. It is found only where its preference for fairly open hill jungles is satisfied. I know this antelope well, for it is common in the Sandur Hills; outside the arena of these hills, it is not to be found. The Chinkara, which used to be common immediately outside these hills and which are still to be found in the surrounding country, are never met within the circuit of the Sandur Hills. I mention this fact as it illustrates graphically the decided preference for habitats shown by wild life. The Sandur area is only about 130 square miles in extent; it is easy for human interference here to alter the terrain or conditions of life so greatly that the Four-horned Antelope of the area may be seriously threatened.

Blackbuck are still to be found in certain parts of the Southern Region, especially in the black cotton soil tracts near the Tungabhadra Dam area, in and around the Hyderabad boundary. Some fifteen years ago, I distinctly remember counting no less than a hundred buck in a single spot in this area, not to mention the innumerable does in the herds. A sight such as that is an impossibility today in that very place, which used to be so replete with these most graceful and purely Indian antelope. Local tribes, who are professional netters of buck for food and sale of meat and skins, and shooting from cars by both licensed and *unlicensed* guns, have contributed to the great decline of the Blackbuck of this area. It is possible to kill off these buck from an area by indiscriminate shooting ; it has happened before.

The decline of these buck and other beasts of open country in places where the Hunting Leopard was once not uncommon is the chief reason for the disappearance of the latter. One still hopes for the survival of stray specimens of the Hunting Leopard in the region—one was reported to have been seen in the Chittoor District recently. Some villagers in the Kopbal District of Hyderabad, near the village of Mukumpi, talk of a rare animal which they call the *Shivanga* or *Shivungi*, which they claim to have seen sitting on the boulders of the rocky terrain. I have good reason to believe that *Shivanga* and *Shivungi* are the Kanarese names of the Hunting Leopard and, although I have not been able to see a *Shivanga* in this locality for all my efforts, I think there is every chance of a few specimens surviving here. Should it be possible to restore a sufficient tract in this area to near the natural conditions of the past, and to effectively prevent the killing of a Hunting Leopard by any means, the species might be restored here. Surely it is worth taking considerable pains to restore the Hunting Leopard to India, if necessary by reintroductions after the terrain has been suitably prepared.

The Great Indian Bustard should also be pretty high in the list of protected animals and birds. I have seen quite a few of them in the black cotton soil areas in the extreme south of Hyderabad, already referred to in connection with blackbuck. They are found wherever there are expanses of flat black cotton soil. I have been seeing them for the last so many years in the blackbuck country in the southernmost parts of Hyderabad. These grand birds are also endangered by the local *Passepardis* who net them, and probably also take away their eggs—and it should be realised the bird is a slow breeder and most often lays but one egg. It is extremely difficult to effectively implement any legislation against the killing or trapping of the Great Indian Bustard without declaring the entire area where they are found a sanctuary. Now if a person kills the bird and is caught by a forest guard, the burden of proof is on the latter, and if the offender has plucked the feathers it is impossible to prove the identity of the bird before the magistrate. Even otherwise this is a difficult matter. Moreover there are few forest guards in the vast open country which is the home of these rare birds and also of *Passepardis.* The setting up of parks and sanctuaries envisaged by the Wild Life Board is good, but not until many square miles of open country are set apart in many places all over South India, exclusively for the animals of the flat open country, can anyone really hope to preserve our wild life —especially the Great Indian Bustard, the Blackbuck and the Hunting Leopard.

Merely to declare certain animals and birds as protected by law is not a sufficient safeguard against their destruction, apart from the administrative difficulties of enforcing protection. For, apart from the environmental conditions necessary for them to thrive, there are so many other animals which enter into their lives, and which are therefore also necessary, directly or indirectly, for them to live in a healthy state. For example, undue check on the predators in a wild community may well lead to the breakdown in the health and fitness of a community of their prey—a result which is seemingly illogical. But life is not logic as every biologist knows. We know precious little about the social lives and the interspecific relationships of our wild life, and even in the West very little work has been done on these aspects of animal life. We do not know much about how the lives of certain animals affect the lives of other animals, how far the predators help to maintain the balance of nature, how much the imposition of artificial conditions by man has undermined their destiny. We do not even know the pattern of life of so many of our animals, their family and social behaviour. However, we know empirically that there is such a thing as the balance of nature, and that *where animals are left undisturbed*, provided there is a minimum biological population to start with, they continue to thrive and survive most of the usual hazards of life, and to live in a healthy state. Therefore, the most effective way of giving protection to animals is to see to it that the entire area which they inhabit, or a good portion of it, is as little disturbed or interfered with as possible. Given protection from disturbance and interference, Nature will look after itself better than we can ever hope to do, with all our meticulous laws and by-laws. This is, in the ultimate analysis, a far more effective measure than merely declaring a few rare or diminishing species as protected, without bothering sufficiently to ensure protection from all other kinds of interference for the whole area or a big chunk of it, in which these species are to be found.

Within a radius of about thirty to forty miles from the Tungabhadra Dam we find country which is admirably suited for a large variety of game, such as Blackbuck, the Great Indian Bustard, the Hunting Leopard or the Cheetah, Chinkara, Four-horned Antelope, Sambar, Tiger, Panther, Sloth Bear, and also small game including the Florican. Within this area there is excellent blackbuck and bustard country (vast stretches of black cotton soil), as well as ideally suited tracts for the Cheetah and the Sloth Bear (open areas interspersed with typical rocky terrain and light scrub jungle). A part of this area in the Kopbal District of Hyderabad used to be swarming with bears and even today there are quite a fair number left. Some twenty-five years ago there is evidence of H. H. the Maharaja Chatrapatti of Kolhapur having sent his men to capture a few Hunting Leopards from this area for his sporting purposes in Kolhapur. These cheetahs were caught, tamed and trained to catch blackbuck. Obviously there must have been quite a few of these animals then. As regards the Great Indian Bustard I have known people who once upon a time have seen them in droves of thirty and forty. I have been a witness to the gradual decline in the numbers of bustards through the years. One can give a large number of reasons for this. But the main reason is of course the increasing disturbance of wild life in this area by the industrial and other activities of our ever-increasing population which has, directly and indirectly, interfered in a thousand and one ways with the normal activities of the animals. To take only one example, the recent Tungabhadra Project near Hospet caused a noticeable reduction in the game in Kopbal. The number of people wanting to shoot, with and without licence, increased. Many enthusiasts from the Project area started disturbing game by endless night drives with searchlights. A local shikari at Mukumpi village, a few miles from Hospet in Kopbal, told me that within the last few months one amateur shikari from the Tungabhadra Project had fired at no less than fifteen panthers in addition to several other animals, which he shot and wounded during night drives. This is only to illustrate the amount of disturbance one single industrial project can cause to the game. This does not of course mean that such projects must not be started, but it does mean that stricter methods of protecting wild life must be evolved, to cope with the encroachment of the noise and bustle of civilisation into the peace of the wilderness. Apart from indiscriminate shooting and slaughter for meat or money, deprivation of territory by the utterly haphazard and needlessly extensive methods of augmenting transport and agriculture, practised by our alarmingly increasing population, can be, and should be, regulated in such areas, if not completely stopped. Four different but closely linked concepts are involved in this last statement. That is, interference with the environment by (*i*) interfering with the flora by forestry work or wood-cutting, or the introduction of new plants intentionally or unintentionally, (*ii*) by shooting or otherwise killing or persecuting a part of the fauna, (*iii*) by disturbing the animals and so interfering with their normal activity—a very potent cause—and (*iv*) loss of territory by needlessly extensive agriculture and transport practices. Is it just fortuitous that the game animals are plentiful in Bandipur and not in Mudumalai ?

Therefore I suggest that if the valuable wild life in this area, viz., radius of thirty to forty miles from the Tungabhadra Project, is to be saved from destruction, the only way is to declare it a National Park, as this will give the best protection by affording concentrated supervision. The wide expanse of water caused by the Tungabhadra Dam itself will increase the value of this area as a National Park. Moreover, only a few miles from Hospet are the historic ruins of the great Vijayanagar Empire. Some of our finest pieces of stone carving and sculpture are to be found here. Hampi, as the place is called, is undoubtedly a remarkable legacy of the past, which must be looked after in the best possible way. Pandit Nehru was very much impressed by Hampi when he visited it recently. As I have already pointed out, many square miles of open country in addition to forest will have to be set aside and preserved as sanctuaries and national parks, if the animals of the flat open country are to be preserved.

The only difficulty in this suggestion is that the area to be made into a National Park or sanctuary will lie in more than one State. It will include areas from Hyderabad, Mysore and Madras. If the Centre was directly responsible for National Parks then there would be no difficulty. Even otherwise it is only a slight administrative problem which the three concerned States can easily solve by mutual agreement.

The Central Wild Life Board has already recommended that Bandipur, Mudumalai and the Periyar in Travancore-Cochin should be made into National Parks. I strongly suggest that attention must also be given to the area I have mentioned; another National Park would be ideal. Attention should also be paid to some good areas in Coorg, such as Nagarahole and Murkal, which may be made into game sanctuaries.

## MEASURES TAKEN, AND EFFECTIVENESS OF CURRENT PROTECTIVE LEGISLATION

In accordance with the suggestion of the Executive Committee of the Central Wild Life Board to the State Governments, to set up State Wild Life Boards and to promulgate wild life protection laws on the lines of the Bombay Law, Mysore and Hyderabad have already set up Wild Life Boards. The Chief Conservator of Forests of Travancore and Cochin wrote to me, saying that it was decided at a conference held recently by the Forest officers of the State, that a Board for Wild Life may be constituted under the name 'Travancore-Cochin State Board for Wild Life,' and that action towards this end is in progress. The Madras Government had deferred the proposal to set up a Wild Life Board till the formation of Andhra State. Now I believe it is under consideration and steps will be taken to set up a Board in due course. Andhra is a new State and I do not know what steps they have taken towards setting up a Wild Life Board. I had suggested to all the State Governments in the Southern Region, in my letter dated 1?th June 1953, to consider taking certain urgent measures, such as prohibiting sale of wild life, netting of wild birds and animals, strictly observing close seasons, discouraging or prohibiting the use of crop protection weapons for purposes of hunting in the forests and lands at the disposal of Government, etc., until more comprehensive measures were taken after the recommendations of the State Wild Life Boards. I had also requested all the Chief Conservators of Forests in my region, and also non-officials who were keenly interested in wild life protection, to give their views on the effectiveness of existing legislation and the measures that should be taken to effectively protect wild life.

The consensus of opinion was that it is *not so much the nature of the legislation as the effective implementation of it* which is the crux of the problem. If the existing game laws were enforced properly they would be adequate to protect game. But the utter inefficiency in enforcing game laws cannot be exaggerated or over-emphasized. The callous indifference and appalling apathy of forest guards who are supposed to be the guardians of the forest is simply staggering. I am convinced of this. To give an example, the sambar in Sandur (S. India) till a few years ago before the State was merged, could be, and were, protected effectively with the same legislation that exists today. One could see forty to fifty sambar in a single drive of seven to eight miles. As a result, tiger started coming into Sandur where they were never known to exist before. Both tiger and sambar increased faster than expectations. But suddenly within the last few years there has been a tragic extermination of the sambar. Poaching and nocturnal sambar hunts with packs of dogs have been responsible for this. The foresters now just do not seem to be interested in stopping it. Game is openly sold for money. The same fate befell the partridges. *Passepardis* caught them by the hundreds and sold them with impunity. I have seen with my own eyes the disappearance of game in Sandur which I had protected and fostered for the last twenty years. I decided to give this example of the Sandur sambar because I can personally vouch for its veracity, and because it illustrates vividly the amount of damage indifferent implementation of game laws can do to game in a short time. It is amazing how fast game can be destroyed. And there is only one explanation to it in the above case—non-enforcement of existing laws. In short, present laws do not encourage wild life. They only prohibit, and they are often unknown and unimplemented.

Issue of game and gun licences in the name of crop protection is another potent cause. Practically all the keen sportsmen I wrote to mentioned this as a grave threat to wild life. It was suggested by the Nilgiri Game Association that gun permits for crop protection should be withdrawn when the crops are garnered. Better still crackers or dummy cartridges should be used for scaring away game from fields. The Chief

Conservator of Forests of Madras also felt that drastic reduction in the number of gun licences for crop protection, and marked increase in the licence fees and deposits for the issue of licence, will go a long way in protecting game. Licences for crop protection provide a cover for a much larger number of unlicensed guns. This aggravates the problem greatly. The problem of a large party of unscrupulous shikaris shooting on a single licence is also a difficult one.

Small game and antelopes require protection from wandering tribes of professional trappers such as the 'Hacci Pacci Avaru' or *Passepardis* who are responsible for the small game being on the verge of extinction. It was suggested at the Mysore Wild Life Board that these people in Mysore State be found alternative employment by giving them lands. There were, however, so many applications, including those from outside Mysore, that the matter had to be kept in abeyance. These *Passepardis* are keen to take to agriculture, as they say small game is now so reduced that they are put to great hardships and sometimes starvation. This is a matter which must be given some serious consideration. First of all, a thorough census must be made of these tribes whose livelihood involves the destruction of small game.

Another piece of information which is worth noting is that all people in Coorg enjoy a free licence and a large majority of them own guns. Clearly this could not be very conducive to the protection of game in Coorg. Free licences ought to be cancelled and licences be issued only to *bona fide* sportsmen. There are quite a few keen sportsmen in Coorg, as elsewhere, who should be made Honorary Game Wardens. This will have a salutary effect on poaching which is going on there, as everywhere else.

The Honorary Secretary of the Peermade Game Association in reply to inquiries made by me writes as follows: (I am quoting from his letter as it brings out certain of the administrative problems of maintaining a game sanctuary. A game sanctuary only becomes a home for poachers if it is not properly supervised.) 'The Periyar Game Sanctuary in Travancore-Cochin State is about 300 sq. miles in area. There are no separate laws or rules in respect of the sanctuary except the laws covered by the State Forests Act. The staff now working under the Game Department is quite inadequate to effectively protect the sanctuary and for preservation work. The staff consists of the D.F.O.-*cum*-Game Warden, Kottayam, Assistant Game Warden (also the Secretary of the Peermade Game Association), one Game Range Officer, two foresters and thirteen guards. Of these, one forester and a few guards are posted for protection work outside the sanctuary. The amenities such as transport facilities, housing conveniences, etc., provided for the subordinate staff are very poor. They have also to be provided with necessary arms and ammunition. The existing paths in the sanctuary are very limited. The opening of a few more paths through the sanctuary will help better patrol work and supervision of the area. For the Periyar Sanctuary, the D.F.O., Kottayam, is also the Game Warden, and his headquarters is at Kottayam, far away from the game area. A separate Game Warden, as was the case when the sanctuary was started, with headquarters in the game area, who could concentrate all his attention on wild life preservation, must be appointed. With dual duty it will not be possible to exercise effective control and personal supervision over the area. . . . The more lowly paid members of the forest staff should be encouraged by a system of rewards, as for instance, a proportion of fines levied. . . . Fines and penalties are not sufficiently deterrent. . . . .

Officials charged with the enforcement of game laws are frequently indifferent. The round up of all unlicensed arms of all kinds, and the severe restriction of licences granted for protection of crops is necessary. . . . Steps should be taken to develop public conscience and to render poaching a hazardous thing, which should almost always land the poacher in trouble. Officials and game preservation staff in general should be impressed with the importance of their work, and with the vital necessity for the most rigid enforcement of game laws.'

The Nilgiri Game Association feels that 'existing legislation is not sufficient to stop poaching. The present maximum fine of Rs. 50 is totally inadequate. It might be increased to Rs. 500 with the alternative of 6 months' rigorous imprisonment and thus brought into line with penalties for breaches of Nilgiri Fishing Rules. In addition, confiscation of weapons and/or motor car is most desirable. Failure to report the wounding of dangerous animals should be punishable with a mandatory sentence of 6 months' imprisonment as is the case under the Kenya Game Rules.'

As regards the Mudumalai Sanctuary, I believe that there is a proposal to increase its area by attaching the Wynaad area. The Wynaad area, I am told, is full of private holdings and Estates, and hence the advisability and wisdom of adding Wynaad to the Mudumalai Sanctuary should be carefully examined.

Lastly, I must mention that widespread publicity to remove public apathy towards the cause of wild life preservation is more important than one imagines. To make the conscience of the nation alive to the great need for wild life protection is absolutely necessary. In my letter to Shri S. D. Udhrain regarding publicity for wild life protection, I have referred to certain ways and methods of giving effective publicity to the cause of protecting our fast-vanishing wild life. It is very important that the generality of people down to those in the remotest village *must* be made aware of the fact that the Central Government considers wild life a valuable national asset, and is earnest about preserving it. This will yield great results and is a necessary psychological preparation for the effective protection of India's vast and varied wild life.

SANDUR,
*December* 31, 1953.

# REVIEWS

1. THE SEALS AND THE CURRAGH. By R. M. Lockley. Pp. 149 ($8\frac{1}{4}'' \times 5\frac{1}{4}''$). Photographs, maps, black-&-white drawings. London, 1954 (J. M. Dent & Sons). 15*s.* net.

R. M. Lockley has specialised in the study of marine creatures. He has already written books on Puffins and Shearwaters; he now writes about the Atlantic Grey Seal.

During the last war, while he was on 'secret official business' for the Royal Navy, Mr. Lockley discovered, on a wild stretch of Welsh coast, a place where these seals had made their summer home and nursery. Here, on the pebbly shore, he counted some hundred seals dozing and playing together in an amicable community life. He made up his mind that as soon as the war was over he would come back here to study their life and breeding habits.

This book, then, is the result of that promised visit. Mr. Lockley sailed to this place in his Irish canoe, and lived on the beach with the seals for more than a fortnight. He made friends with many individual seals, and he came to know their different temperaments and characters. He even became foster mother to an orphaned baby seal whom he calls Billy; he fed it on goats milk and looked after it until it was independent.

Seals only come to the comparatively warmer coasts of the British Isles in order to breed and rear their young. A bull seal captures a part of the beach and patrols it carefully, fighting off all other bull aspirants; meanwhile, cows who are ready to drop their young, gather on this beach and turn it into a communal nursery. It was in this nursery that Mr. Lockley spent his two weeks. He certainly made the most of his time. He has recorded, with the meticulous accuracy of a research worker, the behaviour and breeding habits of his seals. Mr. Lockley's style is so readable that, unlike most authoritative information, it slips down easily. We are grateful to him for writing about this fascinating subject with so much imagination—it doubles the pleasure of finding out what makes a seal tick.

L.F.

2. SOME OF MY ANIMALS. By Maxwell Knight. Pp. 113 ($7\frac{1}{4}'' \times 4\frac{3}{4}''$). 10 black-&-white illustrations by E. M. Mansell, 8 photographs. London, 1954 (G. Bell & Sons). 10/6 net.

This is an excellent book for children. They will love the pictures and photographs and they will enjoy the stories and anecdotes about the animals which Maxwell Knight has kept as pets. Best of all they will absorb a great deal of knowledge of Natural History painlessly and in fact with a great deal of pleasure. Mr. Knight kept some very unusual pets, and acquaintance with their ways would give any child very useful general knowledge of the habits of a cross section of the animal world.

Among Mr. Knight's pets were: tree frogs, bears, civet cats, monkeys, tree snakes, hedgehogs, badgers, parrots, mynas, to mention only a few. Many of these animals lived with their master in his flat at Knightsbridge; they seem to have been quite happy in the city. Mr. Knight tells us that he always made a point of studying each animal's natural habits and tried to provide the environment which conformed as closely as possible to them. The great secret of his success with animals is due partly to the fact that he took great pains to make them happy, and partly to the simple fact that he had very real affection for them.

L.F.

3. INTRODUCTION TO THE BIRDS OF JAMAICA. By Lady Taylor, M.B.O.U. Illustrated by William Reeves. Pp. 114 ($7\frac{1}{4}'' \times 4\frac{3}{4}''$). Paper cover. London, 1955 (Macmillan & Co. Ltd.). Price ?

This is a commendable little guide for one who would acquaint himself with the commoner birds of Jamaica. It deals with about eighty of the species most commonly seen, almost all of which are pleasingly illustrated with black-&-white drawings in the text.

The booklet is divided into six sections—Birds of Lawns and Gardens; Birds of Ponds, Rivers and Reservoirs; Sea Birds, and so on—which again are subdivided into groups such as Humming Birds, Black Birds, American Warblers, etc. Six standards of size are used in the descriptions. An appendix explains the system of scientific nomenclature and gives a list of scientific names of the birds treated in the booklet with the orders and families to which they belong. A useful index completes a useful little booklet.

S.A.

4. THE FRUIT, THE SEED AND THE SOIL. By The Staff of the John Innes Horticultural Institution, edited by W. J. C. Lawrence. Pp. viii+93. Edinburgh, 1954, Oliver and Boyd Ltd. 5*s*.

This is a collection of leaflets issued by the Institution during recent years and its aim is to keep the British horticulturist, nurseryman and fruit-grower in touch with the results of the latest researches in horticulture. It does not deal with fundamental research or theoretical biology, but with the results of experiments to help practical horticulture. There are nine chapters in the book, as follows: (1) Composts for Potted Plants. (2) Soil Ingredients of Composts. (3) A Soil Steriliser. (4) Raising Seedlings in Soil Blocks. (5) Fertility Rules in Fruit Planting. (6) Outdoor Tomato Growing. (7) Growing Pure Seed. (8) Sweet Corn in England. (9) Use of Colchicine in producing new plants.

This list shows that the chapters are of special use for the British grower, and to a lesser extent for the European grower, since even small differences in climate would alter the results considerably. Even the soil composts suggested cannot be used in India because materials like peat are not available and the humus content of our soils is much lower while the oxidation of humus and the release of nitrogen for use by plants is much quicker. The chapter on Soil Blocks may become interesting to us at a later date. These came into use when pots became difficult to get. Soil was compressed in moulds to form blocks and used for sowing seed. The seedlings did not suffer in spite of the compressed soil in which they were made to grow. The fertility rules apply to temperate fruits only. Certain varieties do not fertilise each other and most varieties are self-sterile, so a plan for mixed planting is necessary. Groups have been worked out which must be interplanted to get the maximum fruiting. This suggests the type of work that has to be done on our own commercial fruits specially the mango, of which modern plantations are now coming into being. This knowledge is also necessary for cross breeding. The chapter on Pure Seed should be read by all our seed growers, while the last one on the use of Colchicine is of interest for all interested in biology and modern plant breeding, because although it is 17 years since Colchicine was first used on plants, many people have not yet realised its full significance in plant breeding.

The most important thing about the book is that it points the road along which Indian horticulture will have to travel in the future.

A.J.A.

5. BIRDS OF THE SUDAN. By F. O. Cave and J. D. Macdonald. Illustrated by D. M. Reid-Henry. Pp. 444 (9"×6"); 12 colour plates, 315 line drawings and a map. Edinburgh, 1955. (Oliver and Boyd) 45*s*.

We have now so many books on birds from different parts of the world that it would be difficult to take particular interest in one concerning an area so far away as the Sudan. The present publication, however, is so strikingly attractive that it is difficult not to do so. It is essentially a book for the bird-watcher and is divided into two main parts. In the first entitled 'Introduction to Families', the different groups of birds are dealt with briefly giving the layman an indication of the differences in the field between grebes, petrels, cormorants, darters, pelicans, birds of prey, vultures, and so on. This is followed by a 'Guide to Species' in which each of the 871 species is separately dealt with. A description of the bird is followed by a short reference to its range of distribution and the adjoining races, if any. Throughout the book line drawings assist the reader in following the descriptions, and the quality of the illustrations is guaranteed by the name of D. M. Reid-Henry. Notes relating to habits and nidification are conspicuous by their absence, but then the book is avowedly a guide to field identification only.

There is a valuable appendix entitled 'Principle (sic) Divisions of Vegetation' which is a model of the type of vegetational report that must accompany regional papers. The areas described are also well illustrated by photographs.

This is followed by a short history of bird exploration in the Sudan.

The printing and binding are excellent. The 12 colour plates are very good and of a standard which would indeed be difficult to improve upon. The 315 line drawings and 24 photographs of biotopes add to the value and interest.

H.A.

6. NATURE PARADE. By Frank W. Lane, 4th Edition. Pp.288 ($8\frac{1}{4}'' \times 5\frac{1}{2}''$). Reset and revised with one coloured and 59 black-&-white photographs, Jarrold's Publishers (London) Ltd., 1955. 18*s*.

This is a new edition of a work which appeared some years ago and is an interesting compilation of information regarding various aspects of animal life.

The author in his introduction states that he has consulted over 1,000 books and 5,000 magazines, monographs, abstracts, newspapers and other journals. Press reports on Natural History matters are proverbially unreliable and though experts on various subjects have read over the manuscript it is not at all clear if they have agreed with the facts stated. Some of the stories and incidents recorded must be viewed with doubt, but this is of necessity a matter of opinion.

There are chapters on different aspects of animal food, toilet, speed, leadership, strength, war etc., and the last chapter deals with mysteries in the animal world. The reference to the Abominable Snowman is of particular interest in India. Africa also has its own mystery animals like the Nandi and 'a dark black thing about the size of an eagle . . . whose lower jaw hung open and bore a semi-circle of pointed white teeth . . . ' It is indeed intriguing to speculate what forms of animal life still remain to be discovered on this planet.

This is an extremely interesting compilation and it is hoped that those who have the opportunity will try to confirm or repudiate the many startling interpretations and records of animal life.

H.A.

## 7. PROGRESS OF ZOOLOGY IN INDIA DURING THE YEARS 1938-1950

The utility of well-planned and exhaustive bibliographies, both to the research worker and to the general public, needs no special emphasis. Credit goes to the National Institute of Sciences of India for sponsoring such an enterprise in the cause of zoological science in India. The present publication is planned to appear under four sections, namely (1) General Zoology, (2) Entomology, (3) Fisheries and (4) Parasitology. Of these, the first two sections have been published and a review of both of them together seems appropriate.

1. A LIST OF REFERENCES RELATING TO INDIAN ZOOLOGY (EXCLUDING INSECTS, FISHES AND HELMINTHS) PUBLISHED DURING THE YEARS 1938-50: compiled by B. S. Chauhan [*Rec. Ind. Mus.*, 51 (3): 427-480 (1953)].

The purpose of a good bibliography is to help the investigator find, in the minimum possible time, the references he requires. This bibliography which is broadly divided into two categories, namely, 'General Zoology' and 'Comprehensive Zoology' partly fulfils this purpose. However, no bibliography can be complete, and this dictum is forcefully brought to mind at the very outset by the statement that 'only a few selected references are included here owing to limitation of space, and the bibliography is therefore far from complete.' A supplementary list seems to be in the offing. As far as the general arrangement is concerned one is surprised to find here articles on Oogenesis, Spermatogenesis, Chromosome, Mitosis and Meiosis etc., placed along with morphology, general anatomy, osteology etc., instead of relegating the former to a separate group—Genetics—as the compiler has done for papers on cytology. Neither can there be any justification for the appalling manner in which mis-spellings have been overlooked, or for the completely wrong pagination given against the list of contents, or for grouping of certain papers under the irrelevant subdivision—'Mechanism'. Being part of a project on the progress of Indian Zoology a brief review of the various trends of progress in general and comprehensive zoology would have proved valuable.

On the whole this list of references should prove useful to the amateur zoologist and the general naturalist, while it is doubtful how far it will serve the serious research worker.

2. A BRIEF REVIEW OF THE PROGRESS OF ENTOMOLOGY IN INDIA DURING THE PERIOD 1938-50, TOGETHER WITH A BIBLIOGRAPHY. Compiled by M. L. Roonwal *Mem. Entomol. Soc.* No. 3, 1-119 (1954) Price Rs. 7-8-0 (Foreign: *12s. 6d.*)

The bibliography is prefaced by a detailed introduction and an extensive review indicating the main trends of entomological research in India and these are arranged under suitable subheads which readily make available to the reader the progress achieved during the period under review. The listed references number over 1500, and the main list is augmented by two supplementary lists to make the bibliography complete as far as possible. The task of the future compiler seems lessened by the inclusion of certain references appearing as late as 1953. The references are arranged authorwise in an alphabetical sequence. The compiler has rightly drawn attention to the urgent need for more sustained and critical work and a higher standard of refereeing, editing and printing to be aimed at. To all entomologists keenly interested in Indian insect life, this bibliography should form an indispensable source of reference.

E.G.S.

8. *THE ANNALS OF ZOOLOGY*, Vol. 1 (1). Edited by Prof. B. C. Mahendra. Pp. 1-22 (6¼″ × 9½″). The Academy of Zoology, Agra, 1955.

With the rapid progress of the biological sciences in India, the news of the issue of a new journal for the dissemination of zoological knowledge should be welcomed. The Academy of Zoology, which was founded recently with the object of encouraging research work in taxonomy, anatomy, physiology, cytology, and other branches of zoology, both fundamental and applied, has brought out its first number.

Known as *The Annals of Zoology*, it has as its first contribution a detailed study on the venous system of *Rana tigrina* Daud. by S. Sharma and P. N. Tiku. The journal is of a handy size, and each volume when completed is expected to contain approximately 240 pages. Each volume will be priced at Rs. 15 inland or 30*s*. foreign—post free.

The format and get-up of the journal is pleasing, but it is felt that the printing could be considerably improved. Printed instructions inside the coverleaf as to how the list of References should be prepared and about the dimensions of text-figures and plates etc., would be desirable. Our best wishes go to this latest addition to Indian zoological periodicals.

E.G.S.

9. LIVING FOSSILS. By Maurice Burton, D.SC. Pp. 282 ($8\frac{1}{2}'' \times 5\frac{1}{4}''$) with 83 drawings by Jane Burton. London & New York, (Thames and Hudson). 21*s*.

Few scientists have the gift of expressing themselves on their subject, in anything but its own particular brand of scientific terminology. It should be quite evident to those familiar with Dr. Maurice Burton's earlier publications, that he is one among this gifted minority. In this book, he has dealt mainly with those animals which have been fortunate enough to attain more or less perfect balance with their environment, and thus secure in their ecological niche, let the centuries and the changing world pass by, with but few changes to their gross features. These are the Living Fossils, survivors of ancient groups which vanished from the face of the earth millions of years ago.

In the sixteen fascinating chapters of the book, the author takes us to the far corners of the world, on the trail of the animals to which the term 'Living Fossil' could be most aptly applied. These survivors of a past era are usually more numerous in the regions which became isolated from the rest of the landmass at an early period in earth's history. Here, free from the competition of more highly evolved animals, live the relict species whose pedigree runs back for millions of years. The history, habits, habitat, evolutionary development and the reasons for the continued survival of these living fossils are discussed in detail.

A substantial portion of the book is devoted to 'living fossils' among the invertebrates, for it is among these lowly organisms, that one finds species that are nearly as old as life itself. Among this host of hoary antiquity, the one that holds pride of place is *Peripatus*, a 'missing link' as well as a 'living fossil'. This remarkable animal which resembles a caterpillar, has undergone little change over a period of 500 million years, and possesses characters in common with worms, and the Arthropoda.

The discovery of the century in the field of zoology, and the latest addition to the list of living fossils, is of course the Coelacanth, belonging to a group of fishes believed to have been extinct for seventy million years. A remarkable fact about the Coelacanth is that fossil and living coelacanths show little difference in their structure despite the varied physical environments inhabited by the group during its 300 million year history. Since its discovery off the coast of South Africa in 1938, other specimens have been collected from the same area. One much publicised capture was made in 1952, from off the Comoro Islands near Madagascar. This specimen was named by its collector, with unwitting irony one believes, *Malania*, after the former Premier of South Africa, Dr. Malan.

The causes of extinction are examined in the light of species that have become extinct within recent years. The author after scrutinizing the evidence available from such classic cases as that of the Passenger Pigeon and the Great Auk, comes to the conclusion that extinction is not the result of a single factor but due to a chain of unfavourable circumstances. Another noteworthy point is that gregarious species are more liable to decline under adverse conditions than those which lead a solitary existence.

From the history of 'living fossils' it is clear that survival—like extinction—depends on a number of factors, which are primarily: a habitat which affords protection from the elements and natural predators, a constant food supply, specific longevity, and extended provision for the young.

In the final chapter the evidence, for and against the existence of mysterious animals like the Nandi Bear and the Abominable Snowman are discussed. It is surprising to note the absence of the finding of the African peacock-like bird *Afropavo* in the account of the recent discoveries. The story of this bird is as exciting as a well-written piece of detective fiction. The clues were a single feather in the cap of a Congo native and two moth-eaten specimens in a Belgian Museum labelled as the young of the common peafowl. These made the wheels turn which led to the discovery of this remarkable bird in the late thirties of the present century.

The book is excellent reading and brings together facts which are usually difficult to find under one cover. The illustrations are well chosen.

J.C.D.

## 10. THE WILD FLOWERS OF KUWAIT AND BAHRAIN. By Violet Dickson. Pp. 144 (21.5 × 14 cm.) Profusely illustrated. London, 1955 (George Allen & Unwin). 25*s*. net.

This is a very welcome publication; it is not a text-book of botany on the plants of Kuwait, but it gives a very fair idea of the flora of the district and of other parts of Arabia. In India most of our knowledge of the flora of Arabia is derived from the work of Fr. Blatter, 'Flora Arabica,' and 'Flora of Aden', published in the *Records of the Botanical Survey of India*. My information goes to show that Blatter prepared the MS. of his books mainly in European herbaria; Joseph Fernandes, his assistant, did go to Arabia and make collections in the neighbourhood of Muscat; similarly Col. Hotson sent to Blatter numerous specimens from various parts of Arabia and Mesopotamia;

but in general the work of Blatter was based mainly on preserved European collections. The merit of the present book is that the details therein gathered have been picked up in the field by the authoress, and specimens have been identified by the specialist in Kew Gardens.

There are in all four maps at the beginning of the book; I have nothing but praise for their artistic presentation. The numerous line drawings give in bold outline the main features of the plant; in connection with these drawings I have been agreeably surprised to see that although the authoress is not a trained botanist, she has done what many professionals seem often to forget: she has given the scale for each of her diagrams, and this apparently small detail may help the amateur on the spot to identify the plants. The diagrams are neat, and free from unnecessary detail.

After the diagrams, the most interesting part of the book is the lengthy 'List of Vascular Plants'; the list is an alphabetical one, the order followed is that of the scientific names of the plants. As the book is intended for the amateur, descriptions are simple and in non-technical language; she gives popular uses, and at times tales or traditions, of the plants; the localities where the plant has been seen, and often its flowering and fruiting times are mentioned. Among the Vascular Plants, a full technical description in English is given by Dr. W. Turrill of *Horwoodia dicksoniæ*, a new genus of Cruciferæ collected by Mrs. Dickson. The description is accompanied by neat diagrams showing all the essential parts of the plant in the style that is usual with Kew artists.

From p. 100 onwards, the authoress gives a number of shorter notes on Algæ, on the edible fungi of Kuwait, on the Arabic names of some plants, on some types of vegetation near Kuwait etc.

One point may surprise many of the readers of this delightful book. The authoress speaks of the desert, and yet she mentions a large number of flowers or flowering plants found in the district. This simply means that with a little patience and after a small amount of training, one can find very beautiful flowers even in the deserts; they must be found at their own proper time. It is to the large numbers of technical personnel engaged in the oil business in the Kuwait area that Mrs. Dickson has rendered a special service; this reviewer wishes all success to the book, and in particular that it may help visitors to pay some attention to the sometimes abundant plant life of what is commonly cited as one of the more barren deserts of the world. The presentation of the book, its printing etc. is of a very high standard.

H. SANTAPAU

11. THE BOOK OF INDIAN BIRDS. By Sálim Ali. 5th (Revised) edition. Pp. xlvi + 142, ($7\frac{1}{4}'' \times 4\frac{3}{4}''$) 78 plates (56 in colour by D. V. Cowen), 3 diagrams and 2 end paper maps. Bombay Natural History Society, Bombay, 1955. Rs. 20/- net.

The fourth edition of Sálim Ali's 'Book of Indian Birds' was out of print for some years, and during this period there has been a steady demand for the book. It is a pleasure, therefore, to welcome this revised version. Except for the five general chapters that have been brought up to date, the whole book has been rewritten and remodelled so that we have an altogether new book before us. Instead of a single species each plate now provides four species done from entirely new drawings. Corresponding to this change, the text has been suitably rewritten. Sálim Ali is indeed a master in his subject, and it is amazing how admirably he has given a wealth of information in such a short space. These changes have, moreover, yielded enough space for the inclusion of descriptions and illustrations of 27 additional species in a slimmer volume. Another novel feature is the provision of Hindi names of birds wherever available.

A weakness of the earlier editions was the badly produced coloured plates. In this edition, although considerable improvement has been effected by new drawings and new blocks, yet the printers have not done justice to the talented artist in reproducing them; several of the coloured plates show either a wrong colour combination or are off registration. The defects in the coloured plates strike one particularly, because this book follows so soon after the author's 'Birds of Travancore & Cochin' which has a most pleasing aesthetic effect. Furthermore, except in a few instances, no attempt has been made to 'modernize' the scientific names of birds, as the author has done in his paper on 'Birds of Gujarat' recently published in the *Journal of the Bombay Natural History Society*. In a work like 'The Book of Indian Birds' scientific names may not be an essential feature, but since they have been included, they should have been brought up to date.

The general printing, binding and get-up are neat.

The reviewer sincerely hopes that this only pocket-sized handbook of Indian birds will continue to enjoy the same popularity as its previous editions did.

B. BISWAS

12. SOME BEAUTIFUL INDIAN TREES. By Ethelbert Blatter and Walter Samuel Millard. Second edition revised by William T. Stearn. Bombay Natural History Society, 1954. Pp. xv+165, (24.5×16 cm.); frontisp. +31 coloured plates, numerous black-and-white plates, text-figures. Rs. 20/-

13. SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS. By N. L. Bor and M. B. Raizada. Pp. viii+286 (24.5×16.5 cm.); with 31 coloured and 99 half-tone plates and 154 text-figures. Bombay Natural History Society, 1954. Rs. 22/-

In the course of many years of teaching botany to university students in Bombay, and in my dealings with many visitors to India, particularly during the War years, I have received many inquiries about these two books under review; the first one had been out of print for many years, and it was very difficult to obtain even a second-hand copy; the second book was advertised as ready to appear but the final publication was delayed for years for reasons beyond the control of the Society. The almost simultaneous appearance of the two books is most welcome; persons interested in the subject will be able to obtain both books together. Both books appeared in the first instance in the form of a series of papers published in the *Journal* of the Society; in the present publication there are but a few slight alterations (generally additions) to what has already appeared in the *Journal*. These two books come to fill a real need in India, and will be welcome not only to students but also to all those interested in knowing something of the beautiful resources of the country.

Blatter and Millard's book is in the second edition; Prof. W. T. Stearn, of the British Museum (Natural History) London, has taken great pains in the revision of the book. This reviewer welcomes the additions and changes that have been introduced in this edition: there are several appendices that will make the book most useful to students; the names of many trees have been changed to what is considered the correct scientific name, and the order of treatment in the book has been altered accordingly, so that the final arrangement is by alphabetical order of trees according to their revised scientific names. This edition gives the references to the original publications where the names first appeared (but the system of giving such references is a complicated one, somewhat different from the one recommended by the International Code of Botanical Nomenclature, Appendix VI). The printing of the book is of a very high standard, both for the text and for the plates. In general I find this edition an improvement on the first, with but one exception: some of the colour plates show colours that seem to be rather different from the actual trees represented, the first edition was more accurate in this respect.

Bor and Raizada's book is also a faithful reproduction of the series that has been appearing in the *Journal* in the last 10 or 12 years, with some additions. In the book every family has been given a short introduction; at the end of the book the authors have added a short glossary that will make technical terms intelligible to the general reader. Plants are listed by the names commonly used in gardeners' books, even though often such names are far from correct botanically; to satisfy more exacting readers the authors give the correct botanical name in brackets, wherever the gardeners' name differs from the scientific one. Every plant is given a full botanical description, times of flowering and/or fruiting, country of origin and distribution of the plant, gardening notes, economic uses of the plant.

One word about the colour plates; the beginning of the series was printed by John Bale & Sons of London; gradually as the last World War progressed it became impossible to print such plates in Britain and had to be printed locally; for some time there were plenty of reserve materials in this country and the plates kept up the high standard of the beginning of the series; in time, however, it became very difficult to obtain printing coloured inks, and the quality of the plates deteriorated considerably. It is to be hoped that when a second edition becomes necessary, new plates will be printed from materials that will reproduce the original colours of Ganga Singh's paintings in all their brilliancy.

Another point of interest in the case of the second book, a point that will make the book more attractive to botanical readers. Most of the plants described and illustrated in the book are not indigenous in India, and therefore are left out of most of our local or provincial floras. In my experience it is a very difficult task to identify garden plants in India. In this respect the present book will be a real boon to Indian botanists.

The Bombay Natural History Society is to be congratulated on the almost simultaneous publication of these two books. Together they form a most useful and interesting present to offer to friends on special occasions; both botanists and laymen alike will be happy to possess such beautiful books and to read them at leisure. The price of both books is moderate for this kind of publication, and members of the Bombay Natural History Society will be happy to obtain the books at the reduced members' price offered by the Society.

H. SANTAPAU

BOTANICAL SURVEY OF INDIA,
CALCUTTA.

# MISCELLANEOUS NOTES

## 1. THE ABOMINABLE SNOWMAN

With reference to our Note on the 'Abominable Snowman' on p. 594 of Vol. 52 (2 & 3), December 1954, Col. R. W. Burton has drawn our attention to an article written by F. S. Smythe, the celebrated mountaineer, in *The Statesman* of Calcutta (21 Nov. 1937).

This article would appear to have been overlooked by or unknown to the many people who have in recent years made various conjectures regarding the identity of the creature responsible for the tracks left in snow at high altitudes in the Himalayas—otherwise the Abominable Snowman.

Mr. Smythe mentions coming upon perfect overnight tracks on fresh snow on a pass at about 16,500 ft. above the Bhyundar Valley in the Garhwal Himalayas. They ran for several hundred yards, turned off the ridge and descended a steep rock face. He took pains to make a complete record and close-up photographs. On the level the footmarks averaged 12-13 inches in length and 6 inches in breadth; uphill they averaged only 8 inches in length, though the breadth was the same. The stride was some 1½ to 2 ft. on the level, but considerably less uphill, and the footmarks were turned outwards at about the same angle as a man's. There were the well-defined imprints of five toes 1½ to 1¾ inches long and ¾ inches broad. All the toes, unlike the human foot, however, were arranged symmetrically. What appeared to be the impression of the heel had two curious toelike impressions on either side.

The photographs were scrutinised in London, together with Mr. Smythe's measurements and observations, by Prof. Julian Huxley, Mr. Martin C. Hinton, Keeper of Zoology at the British Museum (Natural History) and Mr. Pocock. They came to the conclusion that the tracks were those of a Himalayan Brown Bear, *Ursus arctos pruinosus*, which varies in colour from brown to silver grey, agreeing with legendary descriptions by Tibetans.

The fact that the tracks appeared to have been made by a biped is explained by the bear putting its rear foot into the rear end of the impression left by its front foot. Thus only the side toes would show as the curious indentations noted on either side of the 'heel'. This would also account for the large size of the spoor, which when melted out by the sun, would appear enormous.

Col. Burton suggests that this more or less convincing diagnosis of the tracks as belonging to the Himalayan Brown Bear may be considered as the 'something more definite' for which the Editors were waiting in the last line of their note!

114 Apollo Street,
Bombay 1,
*March* 11, 1955.

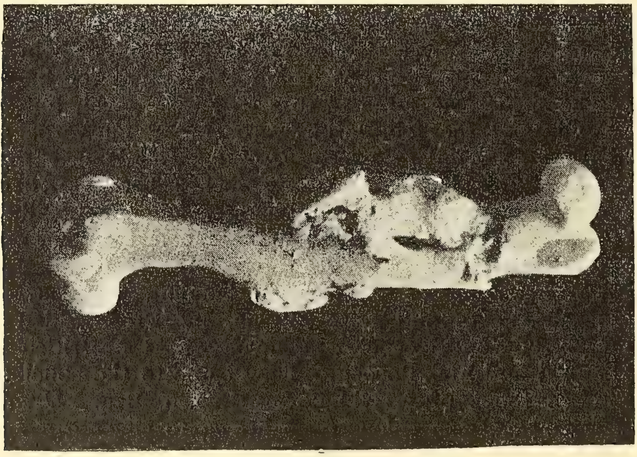
EDITORS

## 2. REMARKABLE RECOVERY OF A PANTHER FROM INJURY

(*With a photo*)

We have obtained from Fr. Fuller, Sacred Heart College, Shembaganur Palni Hills, Madurai District, South India, a panther's femur bone with the following note.

> 'On Monday 13th September 1954, two cows were killed by a panther. The first night the panther returned to one of the cows, had a meal and went away unharmed. On the morning of 15th September it came back again to the same cow and helped itself to a hearty meal and while lying on a rock nearby was shot dead with a rifle. It was a full-grown male and measured 54 inches from nose to root of tail (over curves) with a tail 35 inches long.
>
> 'While it was being skinned, three little dry scabs were noticed on the left rump. Each of them was $\frac{3}{8}$ inch in diameter and arranged in a triangular pattern, $\frac{3}{4}$ inch away from each other. This group of scabs was 4 inches from the centre of the back and 7 inches from the tail (measurements taken over curves). There was no internal wound on the femoral muscles, but the femur on the right side itself was broken, but had joined and healed. This broken femur was nearly two inches shorter than the other.'



As the recovery from such a serious injury seemed remarkable the bone was sent to the Principal of the Bombay Veterinary College who reports on it as follows:

> 'The femur of the panther is from the right side and shows diaphysary comminuted fracture at the proximal third. Due to the epiphyseal traction, the bone is short by two inches, as compared to the normal one on the opposite side. An extensive callus is formed, as a result of the large gap, between the broken ends.'

The photograph will give an idea of the extent of the injury and recovery.

114 Apollo Street,
Bombay 1,
*March* 20, 1955.

EDITORS

## 3. NEMATODES AND HEDGEHOG MORTALITY

While studying the feeding habits of captive hedgehogs, we observed a sudden increase in their mortality, though all the favourable conditions were provided to them. The reason for this incidence was thought to be the spread of some epidemic among them. We dissected some ailing hedgehogs and noticed the presence of innumerable cysts of *Trichinella* sp., throughout the viscera of the animals. Our attention was directed towards the food which was being given to them. At that time we were feeding them on the 'Rat-tailed bats', *Rhinopoma kinneari* Wroughton. On dissecting the bats we found that their alimentary canals also contained a large number of these nematodes.

To ascertain the probability that nematodes were responsible for the mortality, four wild hedgehogs, *Hemiechinus auritus collaris* Gray, were caught. Two were dissected. Every organ was thoroughly examined and found to be free from *Trichinella* sp. The remaining two hedgehogs were then kept in a cage and were supplied with fifty *R. kinneari*. During the first two days they consumed about forty bats. From the third day onwards they ceased to feed and showed signs of lethargy. On the fourth day their sluggishness increased, and on the fifth day one of them took to a corner of the cage and was unable to respond to any stimulus. The other was moving slowly and tumbling down at every step. It showed signs of epilepsy also. Its body trembled violently at intervals. This condition was seen frequently till the evening. On the sixth morning both were breathing spasmodically. Some liquid was also oozing out of their mouths and noses. At 1 p.m. on the sixth day they were reported dead. On dissecting the hedgehogs, nematodes were found in the alimentary canal, pericardium, liver, lungs, and brain. Even the ribs were affected.

It might be interesting to note that these parasites had no obvious effect on three juvenile foxes, *Vulpes vulpes pusilla* Blyth and three adult mongooses, *Herpestes edwardsii ferrugineus* Blanford. These animals were also provided with *R. kinneari*, which had *Trichinella* sp. in their alimentary canals.

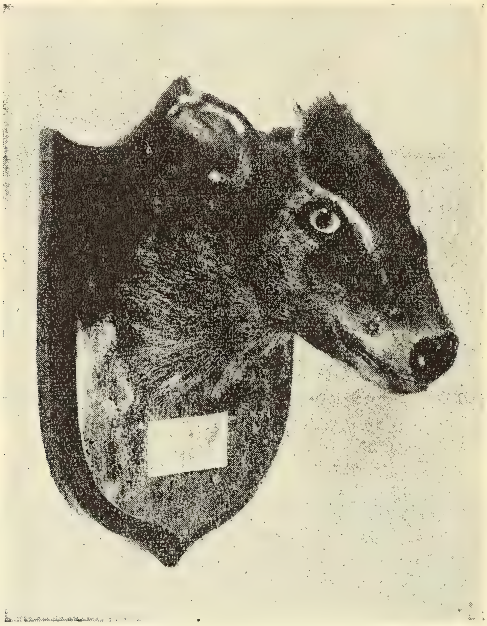
DEPARTMENT OF ZOOLOGY,
JASWANT COLLEGE,
JODHPUR,
*May* 10, 1955.

ISHWAR PRAKASH
S. C. SHARMA

## 4. TUFTED DEER IN BURMA (*ELAPHODUS CEPHALOPHUS* MILNE-EDWARDS)

(*With a photo*)

A male Tufted Deer was shot by a member of the Frontier Development Enquiry Commission near Panwa Pass—longitude 98° 30′, latitude 25°40′, altitude 6,500 ft.—on the 18th December 1954. Enclosed is a photo of the mounted head. D. M. Williams, Esq., also shot a male Tufted Deer on the 4th March 1937 near Hpimaw at a height of 9,000 ft.



Head of the Tufted Deer

The following information was collected regarding the above. Local name: Chik Naw. Distribution : Hpimaw-Hpare and Zuk Lang at high altitudes. Generally come down to lower altitude for breeding. Found singly or in pairs. Lisus consider the *Chik Naw* as an animal of ill omen. They never shoot the Tufted Deer unless by accident. Mating season: April and May. Gestation period about six months. Only one fawn dropped at a time. The colour of the fawn is brownish. The colour becomes dark as the animal grows old. Both male and female bark like the Muntjac during the mating season. Outside the mating season they bark when surprised or scenting danger. The females and young males have no horns. The horns appear only as the males grow up. In old males the points of the horn curve in and face each other.

The average weight of an old male is roughly about 50 lb. The specimen shot was judged as three years old. Each of its horns measures $\frac{1}{4}$ (?) inch in length. Below is an extract from the report on mammals collected by the Vernay-Cutting Burma Expedition (1938-39) by H. E. Anthony, Curator of Mammals, American Museum of Natural History.

> 'These dark Tufted Deer are indistinguishable from a series collected in Western China for which the name *cephalophus* is applicable. From the evidence in hand, north-eastern Burma may be the western limit of the range.

In newspaper accounts of the proposed field work in Burma, before the expedition left the States, some mention was made of a ''black barking deer'' never taken in Burma and an especial object to be sought. Apparently this statement derived in some way from the fact that there is a true barking deer, so called ''black'' (*Muntiacus criniferous* Sclater) of which only three specimens have been recorded (from Chekiang, China), and that a Chinese name for the Tufted Deer can be translated as ''black muntjac''. There was little likelihood that the very local *Muntiacus criniferous* would be encountered in Burma over 1,000 miles removed from the known records. When I saw the first specimens of the Tufted Deer I could readily understand how natural a thing it would be for the layman to call it a ''black barking deer''; size, colour and general appearance all make the name seem appropriate, although it is not a barking deer (*Muntiacus*) at all.

The Tufted Deer has been taken before in north-eastern Burma. Captain E. Maxwell West (1925, p. 1080) gives an account of a hunt ''within a day's march'' of Htawgaw which brought him a specimen of what he called Michie's Tufted Deer. Michie's variety of Tufted Deer is the race confined to south-eastern China, and the Burma animal is not *michianus* but the race discovered in Szechwan by Pére David.

Our specimens were purchased from the natives who brought them in the flesh, making it possible to save complete material.

I saw an animal near our camp in the Chimeti road but was hunting with a shot-gun and loads too light for deer. My native boy and I were coming up the mule trail through primeval forest, interspersed with small openings and at an elevation approximating 10,000 ft. The time was late in the afternoon. The deer was in an opening near the trail and quite close before I saw it. It bounded off into cover at once. I did not see any horns but was impressed by the dark colour and by the white underside of the tail, which was very conspicuous. The tail was carried high, very much like that of our Virginia deer, flopping with each leap.

I believe this deer is to be found in most of the high damp forest of the main mountain ridges of north-eastern Burma.

The second one brought to us was said to have been trapped not far from the Chimeti Pass section and the men carried it for three days to deliver it to us at the Imaw Burma Camp.'

25, Inya Myaing Road,
University P.O.,
Rangoon—Burma,
*April* 9, 1955.

U TUN YIN

## 5. THE INDIAN ELELPHANT (*E. MAXIMUS*): EARLY GROWTH GRADIENT AND INTERVALS BETWEEN CALFING

(*With four plates*)

### 1. Rate of Growth of a Baby Indian Elephant

On February 6th 1950 an adult cow elephant named Deokali, 7′ 6″ in height and belonging to the Forest Department of Assam, gave birth to a baby, subsequently named Parbati. As this event occurred only three miles from my tea estate, I was able to go immediately to photograph the baby on the day of its birth, and subsequently every year on its birthday—February 6th.

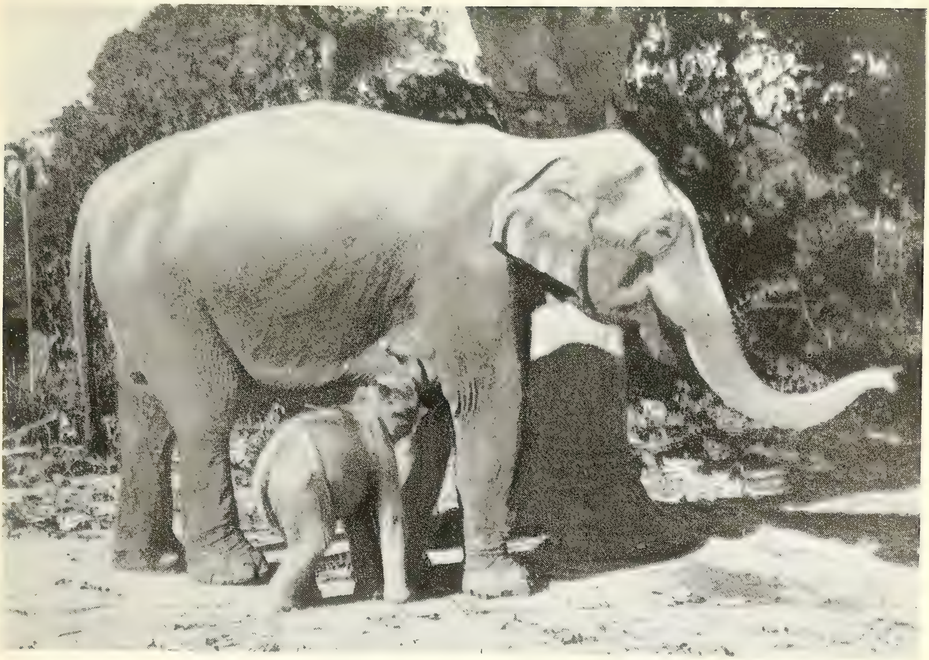
Each year from 1950 to 1955 I have carefully measured the circumference of the forefoot and the height to the shoulder, taking the average after repeating the process four times. Thus an accurate record of the rate of growth of an Indian baby female elephant has been obtained under near natural conditions, as the mother was laid off work and allowed to roam in her forest habitat every day. The heights and other information are as follows:

| *Date* | *Age* | *Forefoot* | *Height* | *Increase* | *Remarks* |
|---|---|---|---|---|---|
| 6-2-50 | 0 | ... | (3′ 0″) | ... | Could not be accurately measured on day of birth. Estimated at 3′ 0″. |
| 6-2-51 | 1 | ... | 4′ 1″ | 1′ 1″ | Forefoot could not be measured. Suckling well. |
| 6-2-52 | 2 | 2′ 4¼″ | 4′ 8½″ | 7½″ | Still suckling. |
| 6-2-53 | 3 | 2′ 6½″ | 5′ 1″ | 4½″ | Still suckling two or three times a day. |
| 6-2-54 | 4 | 2′ 9″ | 5′ 5½″ | 4½″ | Was said to be occasionally suckling. Ridden by *mahout* occasionally. |
| 6-2-55 | 5 | 2′ 11¼″ | 5′ 9″ | 3½″ | No longer suckling. Ridden regularly by *mahout*. |

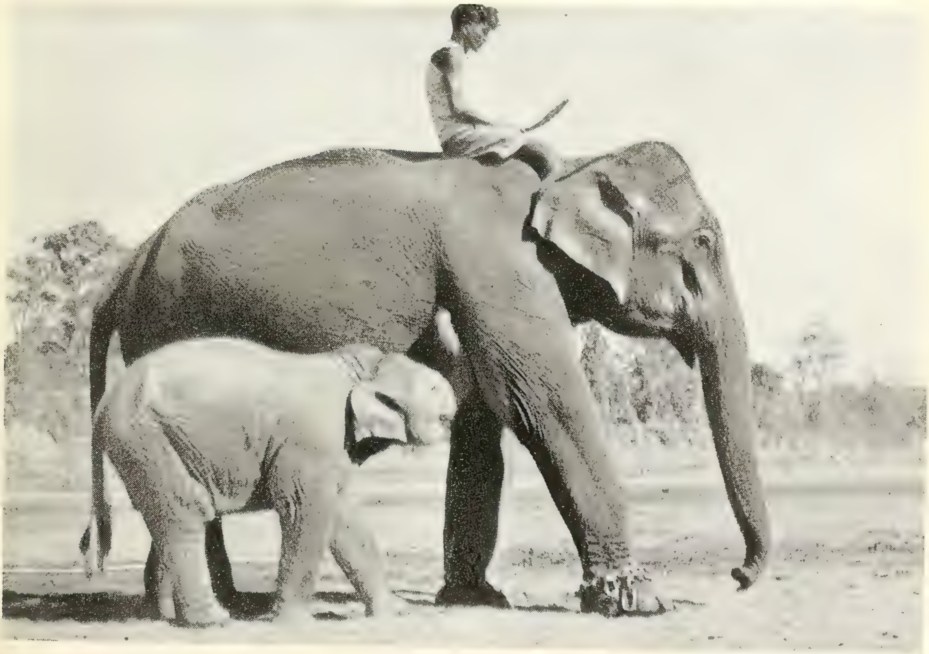
This is probably the only accurate and detailed record of the rate of growth of a baby Indian elephant under near natural conditions. I have studied the measurements given by Gordon Hundley of Messrs. Steel Brothers & Co., Ltd. (*Jour. Bombay Nat. Hist. Soc.*, 37: p. 487), but these appear to be unreliable. For instance, no measurement is given for female calves of two years old; measurements were not taken on the dates of birth and the height given at the ages of nine and thirteen years are less than those at eight and twelve years—which is not possible.

Male calves are slightly bigger than female ones at varying ages, and from a comparison of many figures I estimate that 7% or 8% added to the height of a female calf would give the approximate height of a male calf of the same age (this would apply only to calves between the ages of one and twelve years).

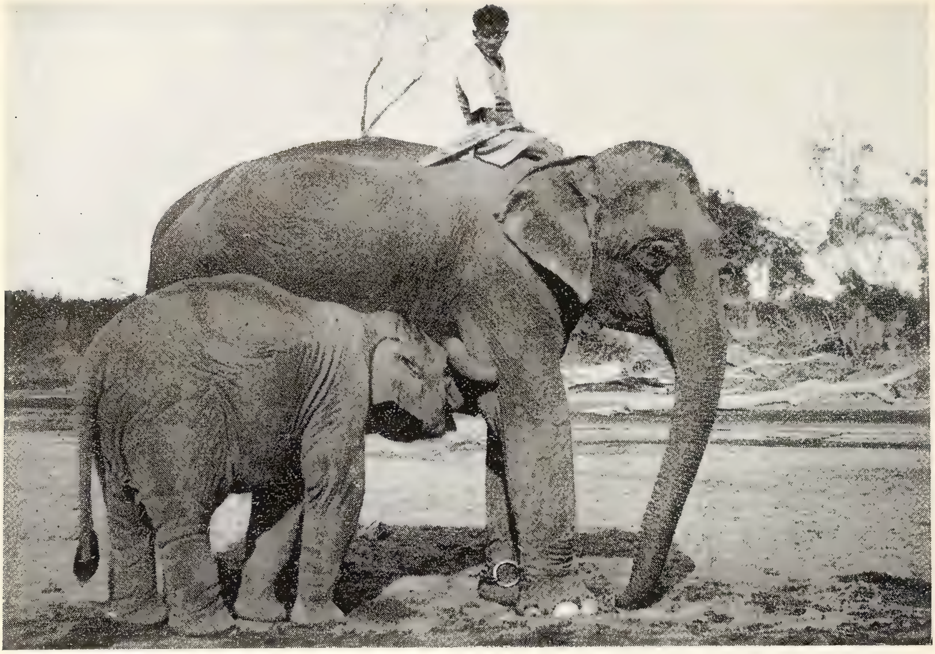
The manner in which Deokali cow elephant came to be mated is interesting. She ran away from her *pilkhana* at Jamguri in the Sibsagar District of Assam on 15-2-45, and spent some years in the nearby forest with wild elephants. Then she was captured along with a herd of wild elephants in *khedda* operations on 15-3-49, in a stockade in the same stretch of forest. She was quickly recognised to be a *ban gharasia* (escaped-tame-one-run-wild), and was claimed by the Forest Department and returned to her former *pilkhana* at Jamguri.



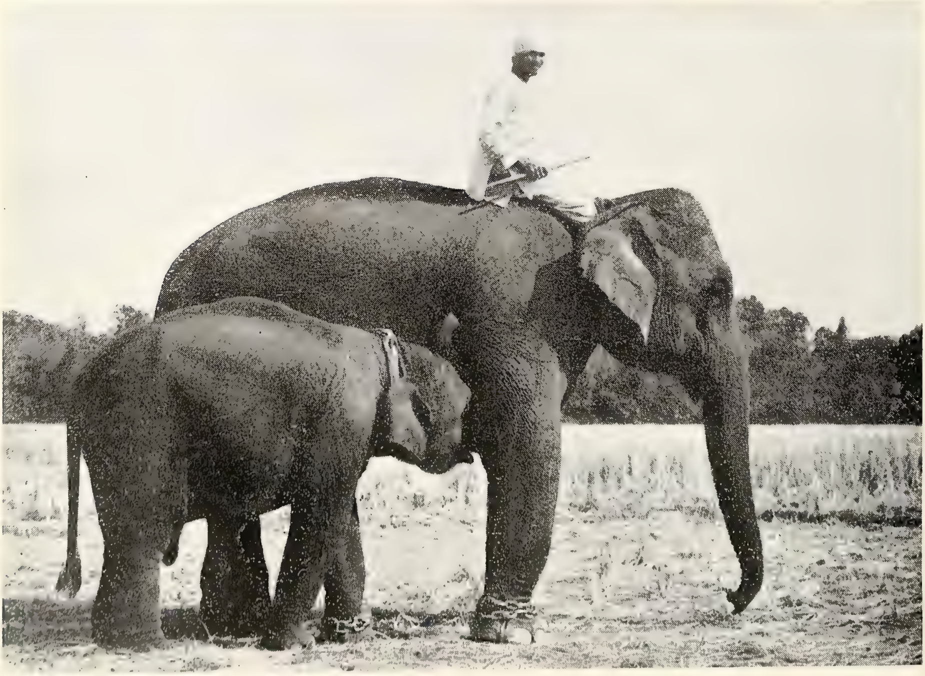
1. On day of birth, February 6, 1950.
Height 3′-0¾″



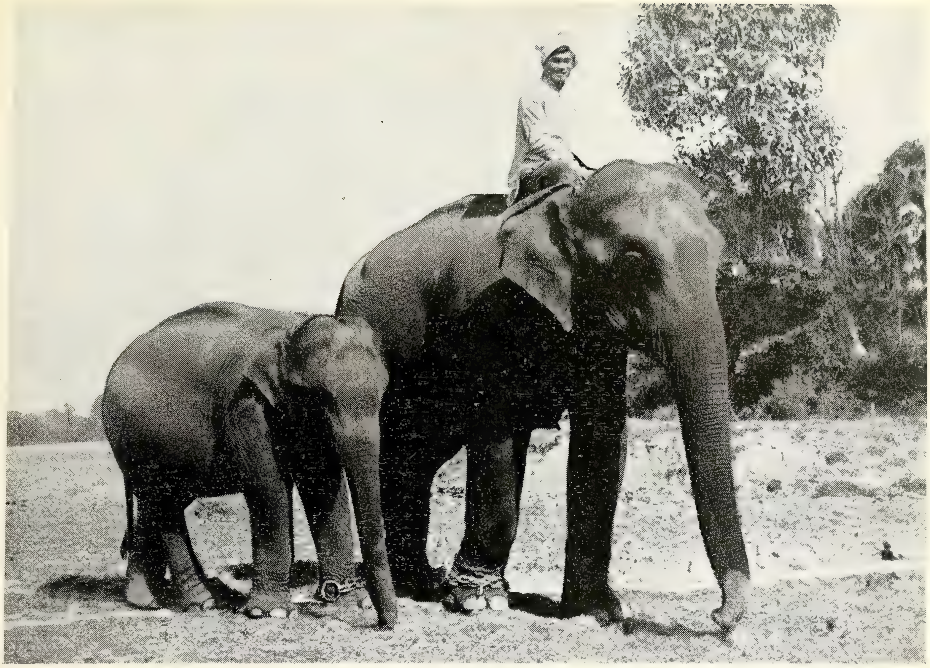
2. February 6, 1951, aged 1 year.
Height 4′-1″.
*(Photos: E. P. Gee)*



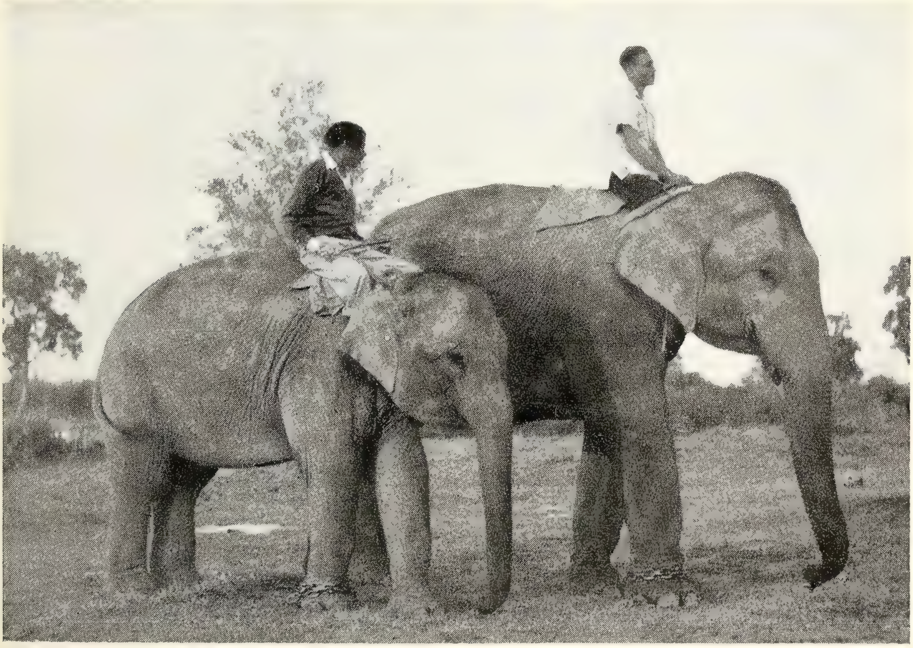
3. February 6, 1952, aged 2 years.
Height 4'-8½".



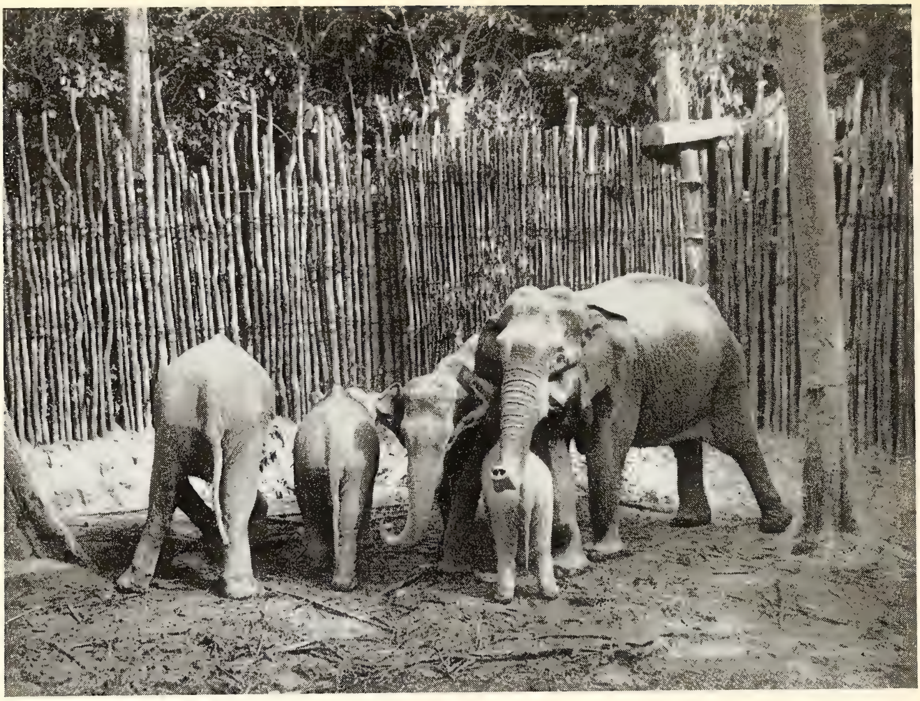
4. February 6, 1953, aged 3 years.
Height 5'-1".
*(Photos: E. P. Gee)*



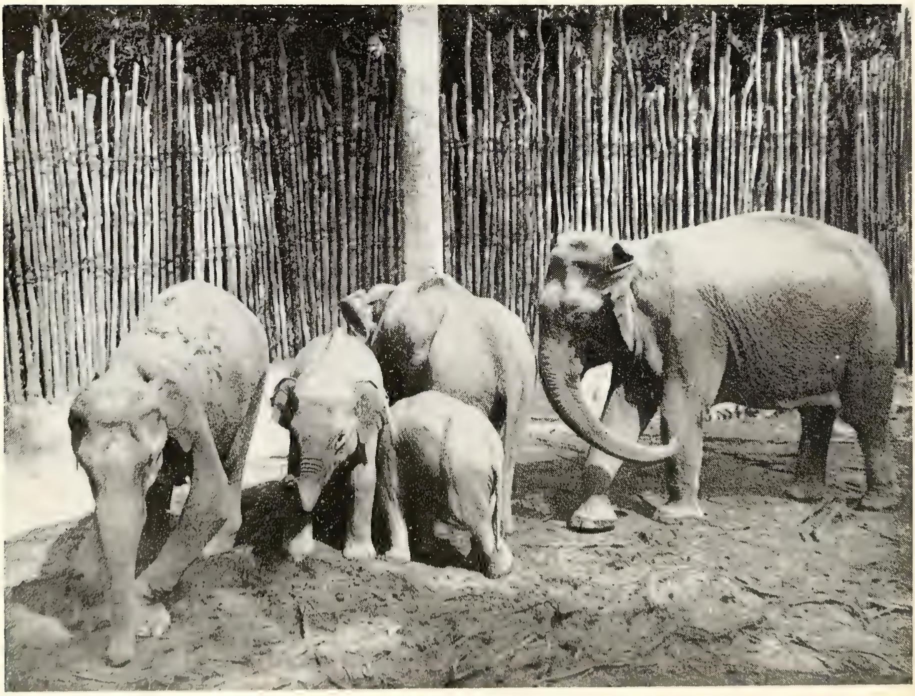
5. February 6, 1954, aged 4 years.
Height 5′-5½″.



6. February 6, 1955, aged 5 years.
Height 5′-9″.
*(Photos: E. P. Gee)*



7. Cow elephant with four (successive?) calves. Heights 4′-1″, 5′-0″, 6′-2″ and unknown.



8. The same herd, showing the deformed calf which had miraculously survived.

*(Photos: E. P. Gee)*

Recently both Deokali and her baby Parbati, now five years old, have been transferred to Kaziranga Wild Life Sanctuary, where both animals are being ridden by visitors coming to see rhino and other wild life in the Sanctuary.

My thanks are due to the Officers of the Assam Forest Department who have always courteously assisted me in obtaining the above measurements and other information required by me from time to time.

### 2. Interval Between Successive Elephant Calves in Wild State

On the night of 17th-18th February 1953 a small herd of five wild elephants was captured in Garampani stockade in the forest not far from Jamguri in the Sibsagar District of Assam. It consisted of an older cow elephant and four smaller female elephants of varying sizes, all of which milled around together in family fashion. The experienced elephant catchers who were there with me all agreed that this was almost certainly a family party of a mother and four calves, possibly successive calves. This appears to be unique in the annals of elephant catching, and the Senior Conservator of Forests, P. D. Stracey, I.F.S., confirmed later after a study of the photographs that it was almost certainly a cow and her four calves. He had himself seen a cow captured with three calves, but never with four as in this case, and his experience in this field is considerable.

Several of the spectators at the stockade were villagers from nearby villages; and they recognised the herd, mainly by the deformed animal, as the very herd of five elephants which had been raiding their rice fields on the fringe of the forest.

The three youngest calves were roped in the stockade and removed to the elephant training depot. As the Director of the Regent's Park Zoo of London had just written to me asking me to obtain a baby female elephant, I immediately purchased the youngest calf, Lakhsmi, which measured exactly 4′ 1″; and this was sent by air about a month later to the London Zoo where she still is. The next calf measured 5′, and the bigger one 6′ 2″. The eldest calf was badly deformed, and was therefore released with the mother.

Now from the measurements of a female calf given in (I) above, it will be seen that Parbati was 4′ 1″ when one year old. Therefore Lakhsmi (4′ 1″) must have been approximately one year old when captured. The next calf at 5′ must have been either three years old or even slightly less, as Parbati was 5′ 1″ when three years old. Therefore it can safely be deduced that in their wild state cow elephants can produce a second calf within two years, or even slightly less, of the first calf. In this particular case the cow must have mated again when her young calf at heel was only about three months old, presuming the gestation period was 21 months.

The largest of the three calves extracted from the stockade was 6′ 2″, and probably seven (or eight) years old. So in this case the spacing was either four (or five) years, or else a calf may have died in the interval.

With regard to the eldest and deformed calf, it was difficult to assess her age owing to her bad condition, and estimates varied between ten and fifteen years. It is probable that she had been trampled on by her mother or by the herd when very young, and had somehow survived. It is significant to note that only by hanging on closely to her mother and sisters had she been able to survive at all. Had she become at any time separated she would almost certainly have been killed by a roaming tiger or by other wild elephants. Much credit, then, is due to the mother for having safely protected such a badly handicapped creature for so many years. I suggested that this deformed elephant should be destroyed, but there was no Forest Officer present at the stockade to authorise this, and both mother and deformed offspring were released into the forest by the catching company.

A similar short interval between the births of Indian elephants was recorded in the case of the young pair in captivity in the Rome Zoo, when the first calf was born in August 1948 and the second as quickly as two years afterwards. The above case, however, of Lakshmi and her elder sister being born within two years of each other may be the first known authentic case of such quick successive births of Indian elephant calves in the wild state.

DOYANG TEA ESTATE,
OATING P.O.,
ASSAM,
*May* 30, 1955.

E. P. GEE

## 6. THE ROSY PASTOR IN THE BELLARY AREA

Jowar is the staple foodgrain of the people of certain tracts in the Bellary area. For eight years I was resident in Sandur State, the area of which is sharply demarked by a double range of hills from the surrounding flat country. Jowar is grown extensively in the Sandur valley, inside the hills, and also along the route leading from Sandur town to Bellary town. The grain comes to a head about November in the Sandur area and is harvested about December—in the surrounding Bellary country both ripening and harvest are later by about a month. These things, of course, are dependent on rainfall and other climatic factors, and I am only giving the periods approximately, from long experience.

One other factor I should mention in a prefatory manner is that the Sandur Hills seem to obstruct in some measure the free passage of bird life between the Sandur and Bellary areas. I had much difficulty in training my Racing Homers (birds of proven worth over long distances) over these hills.

Rosy Pastors arrive in thousands in the Bellary country outside the Sandur hills about September-October. No crop in that area is then ripe, but the birds probably are still to be found there in November when a few early heads of Jowar may be available to them. By December they appear to have quit. The remarkable thing is that they *never* cross the Sandur Hills into the Sandur area where grain is available to them in plenty. On this point I am certain, but having been only an occasional visitor to the Bellary area outside the Sandur Hills, I have formed only rough impressions of the movements of the Rosy Pastors there.

PERUKULAM HOUSE,
EDWARD ELLIOT ROAD,
MYLAPORE, MADRAS,
*February* 19, 1954.

M. KRISHNAN

## 7. NESTING OF HOUSE SPARROWS IN TREES

With reference to Mr. Humayun Abdulali's note on the nesting of the house sparrow in colonies in trees, in your journal, Vol. 52, Nos. 2 and 3, Aug.-Dec. 1954, the following from my records will be of interest.

It was during the months February-April 1950, that the common house sparrow, *Passer domesticus*, was prospecting for house sites in my house in Dhanavaipet, Rajahmundry. Various old crevices under the roof and rafter holes in the masonry had been occupied and the little builders were constantly busy bringing rags, straws, grass and bits of paper, indeed anything they could find to build their nests, inside and flowing out of the holes. There was a medium-sized *Pithecolobium dulce* tree in the back-yard, which was used, as it were, as a halting station both to and fro by the birds, as they flew in and out of the house. Often streamers of rags and papers would get caught in the thorns and remain dangling there. However, I began to notice that at a particular spot in this tangle of twigs of the tree the conglomeration of odds and ends was increasing in size, and soon I noticed that a pair had selected the spot for building their nest. In course of time a large globular affair had been built, much in the manner of the grass nests of jungle mynahs and munias, and a brood was duly hatched out from there. This is the first and only instance I have noticed, in a long period of bird-watching when *Passer domesticus*, reverted to what may be called the wild type of nest structure. There was no mistaking the birds, which were a young pair of the common house sparrow, for they often came into the house for picking up morsels.

GANDHINAGAR,
KAKINADA,
*February* 17, 1955.

A. S. THYAGARAJU, M.A.

## 8. THE COURTSHIP (? DISPLAY OF THE BLACKBACKED INDIAN ROBIN [*SAXICOLOIDES FULICATA* (LINN.)]

A slightly cloudy morning and many birds were about. It was the middle of October (1929), when the courtship (?) display of this little robin was observed in the front garden of my house in Batchupet, Masulipatam.

The hen bird was hopping on the ground and running about, with its tail very much erected, almost perpendicularly. The male bird alighted on a twig of a tree, just above the spot where the female was hopping about, and began to whistle a few notes. Next he also flew down to the ground and began to strut near the hen, much as a turkey-cock would do; his tail was stiff and pressed down, touching the ground. This performance was repeated three or four times, when they both began to feed, with the tails let down and not cocked up.

GANDHINAGAR,
KAKINADA, A. S. THYAGARAJU, M.A.
*February* 17, 1955.

[A rather more elaborate description of the same display is given by Capt. C. R. Stonor in *The Ibis*, 1944—Vol. 86, p. 91—EDS.]

## 9. OCCURRENCE OF THE WHITEWINGED BLACK TERN (*CHLIDONIAS LEUCOPTERUS* TEMM.) IN SAURASHTRA

On 12-5-55 watching Avocets on a lake near Jasdan, I had the good fortune of seeing a Whitewinged Black Tern among a flock of Whiskered Terns. The bird flew very close to me and I had an excellent opportunity of noting its distinguishing characters. The black head and body, and white shoulders and tail are impossible to overlook, nor is it possible to mistake it for any other tern found here.

This is a second record for Jasdan and Saurashtra, the first being in June 1949 on a lake close to this one. This record, I understand was the first for the west coast of India, the previous ones having been from the Persian Gulf and Ceylon. Mr. Humayun Abdulali subsequently saw one near Bombay on 26th March 1950.

JASDAN,
SAURASHTRA, SHIVRAJKUMAR
*May* 13, 1955.

## 10. BREEDING OF SARUS CRANE [*ANTIGONE A. ANTIGONE* (LINN.)] IN CAPTIVITY

A pair of Sarus Cranes in our Calcutta Zoo occupies an enclosure measuring about 187′ × 195′ along with some Nilgai, and there in a shallow pool in it lives a Gharial. This association of animals varying so widely in habit and character is no doubt very strange and unusual. Nevertheless they have been living there for many years in perfect peace and harmony. In this surrounding, the pair of Sarus was observed to build a nest, breed, hatch out a young and rear it during July-August, 1949.

Nest.—A shallow nest measuring approximately 2′-10″ in diameter was built at a distance of 2′-2″ from the water's edge. The nesting materials were twigs of Peepul (*Ficus religiosa* Linn.), Banyan

(*Ficus bengalensis* Linn.), leaves of Date (*Phoenix sylvestris* Roxb.), pieces of bones and other unusual materials that were handy inside the enclosure.

The nest, very simple and hardly 3.5″ in depth, contained only one egg. Both cock and hen birds shared equally in nest building.

Incubation Period—The bird (birds?) started sitting on the egg from 14-7-49 and successfully hatched out a chick on 10-8-49 recording an incubation period of 28 days. There appears to be no previous record of the period of incubation of the Sarus Crane.

Blaauw in his Monograph of the Cranes observes: 'I find no exact information about the time of incubation of this Crane, but think it probable 30 days will be about the duration of it.'

The parents continued to keep constant watch over the chick and nursed it very carefully.

The Gharial who knew his old friends in the enclosure was apparently surprised at the sight of the new-comer. He did not seem to like the chick's unfamiliar presence inside the enclosure and felt excited. On several occasions when the chick moved into water along with its parents, the Gharial was observed to chase it as far as the edge of the water. Curiously enough, in each and every attempt of the Gharial to get at the chick he was repulsed and driven back by the parent birds in the usual Sarus manner by flapping of their wings and brave and loud trumpeting.

Food Habits—Evidently there was enough of available natural food on the site for the chick has been growing unusually fast and keeping healthy and buoyant. Earthworms apparently form the principal item of its food.

At first either of the parents was observed to dig out earthworms and collect aquatic as well as other kinds of insect food (grasshoppers, etc.) for the young and hold them at the level of the chick's beak, when the latter would take it rather lustily. No grain food was given by the parents to the chick at this stage.

The chick having now grown up, the parents would no longer follow the same process of feeding. They no doubt sought out the food as before, but instead of holding the same in their beak in front of the young they would dangle and drop it on the ground before the chick until it realized that it was something to be picked up by itself. Thus the Sarus Crane teaches its young the way of sef-feeding.

It is interesting to watch a week old Sarus going freely into the water and swimming back to land unaided and unattended.

ZOOLOGICAL GARDENS,
ALIPORE, R. K. LAHIRI
CALCUTTA 27,
*June* 6, 1955.

## 11. WILSON'S PETREL [*OCEANITES OCEANICUS* (KUHL)] IN INDO-CEYLON WATERS, WITH SPECIAL REFERENCE TO THE 1954 SOUTHWARD MIGRATION

In my recent paper 'Petrels, Shearwaters and other Oceanic Birds in the North Indian Ocean' (see *Journal B.N.H.S.* Vol. 52, p. 334) I recorded certain interesting observations made during 1953 by Mr. G. N. Grisenthwaite from the Ceylon Government Trawler '*Braconglen*' in Indo-Ceylon waters, off Cape Comorin, the most southerly point of India. During 1954 Mr. Grisenthwaite continued his observations during his frequent voyages in these same waters; the present note is based upon his reports submitted on his return to port.

### NORTHWARD RETURN OF WILSON'S PETRELS (*Oceanites oceanicus*)

No petrels were observed between 8th November, 1953 and 26th May, 1954. At 10.30 a.m. on 26th May, however, when '*Braconglen*' was about 20 miles south of Cape Comorin, Mr. Grisenthwaite observed a solitary Wilson's Petrel and by the evening 'quite a few' had appeared, attracted to the vicinity by the oil that the fishing operations leave on the surface; no shearwaters were seen. That evening one petrel came aboard, attracted by the powerful deck lights, and two days later, i.e. on 28th May, another one was captured. The first was taken 19 miles SE. of Cape Comorin and the second 11 miles W. of the Cape. Both were in fine, fresh plumage; they were sent to Mr. J. D. Macdonald at the Bird Room, British Museum (Natural History), for determination of the races to which they belonged.

Mr. Macdonald, in his letter dated 6th December, 1954, reports: 'On measurement the ♂ is *O.o.exasperatus* and the ♀ could either be that race or *O.o.oceanicus.*'

### DURATION OF STAY IN INDO-CEYLON WATERS

Wilson's Petrels continued to be observed by Mr. Grisenthwaite on each voyage after 26th May, 1953, until early November. Generally they were observed from just clear of Colombo Harbour to the edge of the Continental shelf. Across the deep water they were usually absent, but they became abundant again when the shallower waters south of Cape Comorin were reached. No shearwaters were seen until the voyage of 9th to 20th July when one solitary, dark shearwater (probably *Puffinus pacificus chlororhynchus*) was observed.

Leaving Colombo Harbour on 27th July, Mr. Grisenthwaite reports 'I was immediately impressed by the large numbers of Wilson's Petrels present; just clear of the harbour they were like flies. Gradually we lost them on the way across (the deep water) but when we arrived off Cape Comorin and commenced fishing operations, we were amongst very large flocks. During the hours of darkness, when our searchlights were on, one night alone we released 51 of these petrels and it was usual to have from 15 to 25 on board during each night. They were all Wilson's Petrels. Several flocks of 20 to 30 shearwaters were also observed but they all kept fairly far away.

### SOUTHWARD MASS-MIGRATION 1954

In 1954, all or almost all Wilson's Petrels appear to have left Indo-Ceylon waters on their southward migration to their breeding grounds in the Southern Hemisphere, on 5th November—three days earlier than in 1953.

Mr. Grisenthwaite reports: 'On 5th November Mr. P. L. N. Mendis, the Ceylonese Fishing-Skipper, called me, quite excitedly, on to the bridge. He had noticed ahead what appeared, at first sight, to be three or four large patches of seaweed but when I looked through my glasses I could see four very large flocks of petrels, packed together and sitting on the water; there must have been thousands of them! As the ship closed them, they rose in a cloud and flew in one body away to the south and west. As the sea was dead calm, we watched them until they were out of sight. Since then, we have not seen a single petrel. On 6th November, we had a strong north-east wind, approaching force 4.'

From Mr. Grisenthwaite's observations we now know that:

(*a*) Wilson's Petrels, of several races, arrive in Indo-Ceylon waters during the last week in May; they arrive flying independently and not in large flocks.

(*b*) Many remain in Indo-Ceylon waters, chiefly in the shallower coastal areas of both India and Ceylon, for approximately six months.

(*c*) They collect in very large flocks in the Gulf of Mannar during the first week of the following November and fly southwards in mass-migration, leaving Indo-Ceylon waters generally during the first or second week of November.

### ACKNOWLEDGEMENTS

My grateful thanks are due to Mr. G. N. Grisenthwaite for furnishing his interesting reports and to Mr. J. D. Macdonald for determining the races of the Petrels sent to him for identification.

CEYLON,
*February* 11, 1955. W. W. A. PHILLIPS

## 12. SOME NEW BIRD RECORDS IN THE PALNI HILLS, SOUTH INDIA

In the last week of October 1954, I had the opportunity of making a small collection of birds around Shembaganur, 6,000 ft. elevation in the Palni Hills. These have been identified by the Society and I am informed that the following are not listed by Fairbank and Terry from this area (*Stray Feathers* Vol. 5, Pp. 387-410 & Vol. 10, Pp. 467-480):

*Microtarsus poioicephala* in foothills *ca.* 1000'.

*Rhipidura aureola compressirostris.* (In the Eastern Ghats Report, *JBNHS*, Vol. 36, Pp. 92, Whistler doubted Fairbanks's record since the latter had omitted *R. pectoralis*).
*Strix i. indranee*
*Astur t. trivirgatus*
*Accipiter nisus nisosimilis*

St. Xavier's High School,
Bombay,
*January* 24, 1955.

Br. A. NOVARRO

## 13. EXTENSION OF RANGE OF THE LIZARD *CNEMASPIS KANDIANA* (KELAART)

On 16th January 1953, I picked up a lizard in the dak bungalow at Yellapur, North Kanara, which was identified at the Indian Museum as *Cnemaspis kandiana* (Kelaart). On 31st November 1954 another was obtained under a stone in forest at Mahableshwar, 4,500 ft., Satara District, Bombay. Subsequently V. K. Chari and J. C. Daniel of the Prince of Wales Museum obtained two more at Mahableshwar on 10th December 1954, one in a house and the other under a stone.

The Fauna (Smith, 1935) gives the distribution as 'Ceylon and hills of Southern India as far north as latitude 12°; Jog, North Kanara Dist., where Dr. Rao collected a single specimen in 1928; the Andaman Islands; islands west of Sumatra'. The present records, therefore, constitute a considerable northward extension of the known range of this species.

C/o Faiz & Co.,
75, Abdul Rehman St.,
Bombay 3,
*March* 15, 1955.

HUMAYUN ABDULALI

## 14. PYTHONS

The note on the congregation of Pythons, by Mr. Frank Nicholls in the Miscellaneous Notes of the *Journal* for Aug.-Dec. 1954, is of considerable interest, but it would appear that this habit is not of such unusual occurrence as might be supposed.

On Christmas Eve 1934, I was on a shooting party in the Darjeeling foothills. We were beating for junglefowl on some grassy islands in the bed of the Sivoke River about a mile above its junction with the Teesta, at about 400 ft. elevation. I was on an elephant with the beaters when one of the men came running up, saying that he had just seen a large snake. I turned the elephant back, and the man led me to a pile of dead grass and leaves and said the snake was lying inside it. I dismounted from the elephant and poked around in the heap of grass with a stick, whereupon a large python stuck its head out and hissed at me. I shot it then and there and, as it wriggled about in its death throes a second python emerged from the far side of the heap and made off through the surrounding elephant-grass. I chased after it as it dodged through the clumps of long grass, and eventually succeeded in catching up with it by stamping on its tail and, running round to the other end, I shot it in the head. This one measured 17 ft. No sooner had I shot it than I heard the beaters shouting that there was still another one in the pile of grass, so I went back and despatched that.

A friend who had also been coming along with the beaters, on hearing the shots, now came up, and I asked him if he would like to shoot a python. On his agreeing, we again poked about in the pile of grass and, sure enough, a fourth python slowly crept out, which he shot. The beaters then told me that yet another python had crawled away and escaped in the long grass while I was chasing the second one. Five pythons together in all.

The four we shot measured between them over 60 ft., the biggest being 17 ft. and the smallest 12 ft., so they were all evidently mature specimens. The skins, as far as I remember, were fairly new, and as this happened in the cold weather the circumstances almost exactly coincide with those of Mr. Nicholls's case.

On another occasion, in February 1954, I found a similar heap of dried grass with four adult pythons in it. This was in an area of long grass in the bed of a dry stream that joins the Mechi River just inside the Nepal boundary opposite the Darjeeling Terai at the foot of the hills at about 500 ft. elevation. On prodding the heap of grass the pythons all crawled out and disappeared in the surrounding jungle.

As both Mr. Nicholls's and my own experiences were in the winter, it would seem that the pythons may have been in a state of semi-hibernation. None of the snakes that I saw appeared to have recently fed, at least none of their bodies showed any bulging signs of freshly eaten animals.

VICTORIA, SEYCHELLES, C. J. T. WRENICKE
*April* 20, 1955.

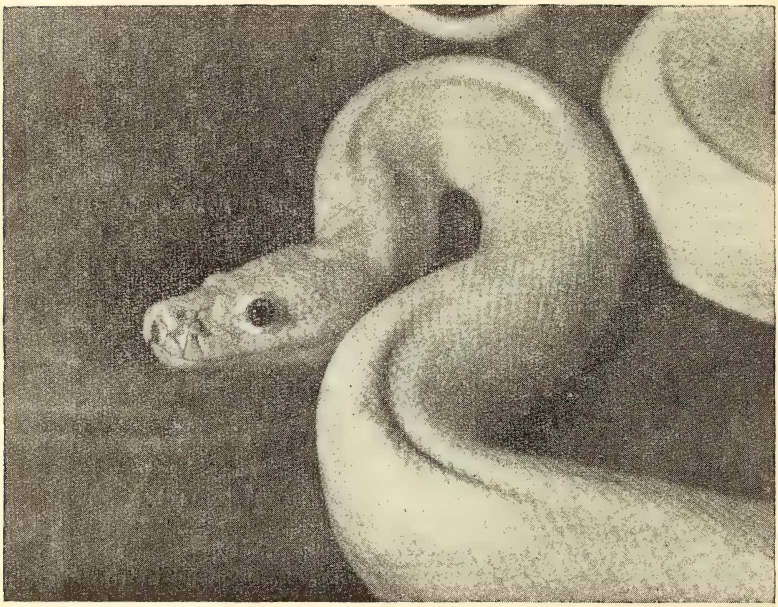
## 15. A 'WHITE' PYTHON

(*With a photo*)

In December 1954 information reached this Zoo regarding the availability of a 'white' Python in possession of a local animal dealer. The specimen was being shown at various places in and around Calcutta in a small crate by its owner. On February 18, 1955, the snake was brought to the Zoo for detailed examination and the following were recorded:

| | |
|---|---|
| 1. Colour ... | ... Uniformly ivory-white with no blemish nor any marking. |
| 2. Length ... | ... 7′-6″ |
| 3. Tail ... | ... 1′-0″ |
| 4. Max. girth | ... 9″ |
| 5. Neck ... | ... 4·5″ |
| 6. Weight | ... 8.5 lb. |
| 7. Colour of Iris | ... Brownish black. |
| 8. Sex ... | ... Male. |

From the characteristics of its scales, it appeared to be a Rock Python, *Python molurus*.



The dealer reported that the reptile had thrice shed its skin at his place and no change in colour was observed during the period.

It is being force-fed on meat, fish such as *Ophicephalus punctatus* etc. by an outside snakeman once a week and is thriving well. It is, however, seen that the growth is rather slow and the snake looks somewhat emaciated.

A foreign animal dealer who has recently purchased the specimen checked feeding by offering live white rats and red munias. The snake very greedily caught and devoured two white rats and three munias.

The exact locality of procurement could not be ascertained, but it is stated to have been secured through a village snakeman from the hill tract north of Jalpaiguri.

I am unable to trace any record of a similar freak in Python in the standard books.

Zoological Gardens, Alipore,
Calcutta 27, R. K. LAHIRI
*June* 6, 1955.

## 16. ON THE ALLOCATION OF THE NAME *COLUBER PLATURINUS* SHAW

Recently while preparing a paper dealing with the subspecies of *Lycodon subcinctus* Boie (1827, *Isis*, 20, p. 551), my attention was drawn to the reference in Duméril, Bibron and Duméril (1854, Erp.

Gen., 7, p. 598) in which they place the name *Coluber platurinus* Shaw (1802, Gen. Zool., 3, (2), p. 468) as a questioned synonym of *Ophites* (=*Lycodon*) *subcinctus*.

On checking the literature it was further determined that Cantor (1847, *Jour. Asiatic Soc. Bengal*, 16, (2), p. 916) had suppressed the name *subcinctus* in favour of Shaw's terminology. Günther (1864, Rept. Brit. India, p. 322), however, placed Shaw's name in the synonymy of *subcinctus*, stating in a footnote, 'As it was impossible to recognize this species from Shaw's description, the name proposed by him has no claim to priority.' Subsequently Boulenger (1893, Cat. Snakes Brit. Mus., 1, p. 359) placed *Lycodon platurinus* Cantor (*not* Shaw) in the synonymy of *subcinctus*, and completely neglected to indicate what was to be done with Shaw's name. Recent authors (e.g., de Rooij, Rept. Indo-Aust. Arch., 1917, vol. 2; Taylor, Snakes Philip. Ids., 1922; Pope, Rept. China, 1935; Smith, F.B.I., 1943, vol. 3) have not even mentioned the name *platurinus*, either of Shaw or of Cantor, in their synonymies.

An examination of Shaw's description leads one to the conclusion that it would be impossible for his name to be applied to any species of *Lycodon*, and it becomes quite evident that Shaw and Cantor were not speaking of the same snake.

A careful examination of this problem has led to the conclusion that *Coluber platurinus* Shaw was undoubtedly based upon a specimen of snake referrable to the genus *Bungarus*. The description of *C. platurinus* as given by Shaw (*op. cit.*) is as follows: '. . . back slightly carinated, sides somewhat sloping, and abdomen flattish: colour of the whole animal an equal variegation of broad blackish-brown and white bands, equidistant from each other, and entirely surrounding the respective parts: the white bands are spotted with black: head rather large than small, covered with large scales of a black-brown colour elegantly separated from each other by intervening white spaces, so that the head appears marked with large black spots on a white background: nose abrupt or truncated: tail very long, slender and gradually tapering to the extremity: length of the whole animal about three feet and a half: scales of moderate size, ovate, and not carinated.' (No scale counts are given!)

Certainly from the information given in this description (note particularly the statements in spaced type which present what I believe are the most critical points of the description) there can be little doubt but that Shaw was describing one of the kraits (genus *Bungarus*) and most definitely not a *Lycodon*. Furthermore, from the nature of the coloration, e.g. 'the broad black and white bands, equidistant from each other, and entirely surrounding the respective parts; . . . head appears marked with large black spots on a white background,' and so forth, it seems highly probable that he was examining a specimen of *Bungarus fasciatus* (Schneider, 1801), the so-called 'banded krait' (see Smith, op. cit., p. 416, for comparison of description); his reference to Seba's plate (2, t. 83, fig. 2), which he questions anyhow (note question mark immediately following reference), possibly resulted from the great similarity in dorsal coloration of his specimen to Seba's figure (probably *L. subcinctus*, *fide* Cantor, op. cit.).

Thus, it is believed that *Coluber platurinus* Shaw should be considered a synonym of *Bungarus fasciatus* (Schneider); *Lycodon platurinus* Cantor must be placed in the synonymy of *Lycodon subcinctus subcinctus* Boie.

NATURAL HISTORY MUSEUM,
STANFORD UNIVERSITY,
STANFORD, CALIFORNIA, U.S.A.,
*January* 24, 1955.

ALAN E. LEVITON

## 17. FISHERIES OF CERTAIN TROPICAL FISHES IN NATURAL COLD WATERS OF INDIA[1]

During a recent zoological survey of the Kashmir Valley (May-June, 1954), the wide occurrence of the Central American Poecilid Mosquito-control Fish, *Gambusia* (*Schizophallus*) *holbrookii* Girard (Original home: Atlantic Coast drainage from New Jersey to Florida and adjoining gulf drainage), attracted our early attention as the fishermen showed curiosity in having a fish which gave birth to young ones instead of liberating eggs as all other fishes found in the Kashmir Valley do. Such a curiosity was, however, felt in the U.S.A. also when the fish was introduced there for the first time. Innes (1944, p. 311) writes:

> 'To many aquarists, at least in the United States *Gambusia affinis* represents the beginning of an epoch. It was our first live-bearer. The species was advertised by dealers as the eighth wonder of the world. All flocked with their $ 2 per pair to prove or disprove for themselves the claims for this strange fish.'

Mr. G. M. Malik of the S.P. College, Srinagar, who has considerable acquaintance with the fish fauna of the Valley, had not seen or heard of it when he was in charge of the Game and Fish Service of the Kashmir State. The fishermen had observed this fish in natural waters only a couple of years ago and now keep living specimens in earthen pots to verify for themselves and to show to others the birth of young fish from pregnant females.

No record of the introduction of *Gambusia* in the Valley could be obtained. Specimens were collected from the Dal Lake (Dal Ghat, Srinagar; Nishat Garden Ghat; Tel-bal stream and adjoining portion of Dal Lake), Wooler Lake at Ningle; Manasbal Lake; and from paddy fields about 7 miles from Srinagar on the way to Tangmarg. Whoever may have taken the fish to the Kashmir Valley, either as an aquarium fish or for public health purposes, *Gambusia* is now firmly established in the natural waters of the Kashmir Valley.

As a larvicidal fish, it is reputedly very efficient and 'its practical value is enhanced because it can live in good or bad water, and will stand a temperature range from 40 to 100 degrees' (Innes, loc. cit.).

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[1] Read at the 42nd Session of the Indian Science Congress held at Baroda in January 1955.

In his letter dated October 19, Mr. Malik sent me the following note about the habits of this fish in the Kashmir Valley:—

'1. *Gambusia* has stopped breeding in September.
2. Instead of remaining scattered on the surface water it has formed big shoals and concentrated in the spring-fed warmer regions of the lake. This has synchronised with the arrival of the cold season.
3. It has left the colder regions of the lakes and moved to warmer areas in vegetation or to spring-fed areas.
4. It has passed through the Jhelum and spread in Nagin, Manasbal and Wooler lakes and also in other still waters and marshy areas round the Valley.
5. It does not live in the Jhelum either in summer or winter. The reasons can be the comparatively strong current and colder water.
6. It prefers to live in still waters where the water is slightly warmer and above 52°F. It avoids generally all waters below 50° F.
7. With the disappearance of mosquitoes in the lake in early September, it has begun to feed on surface swimming water fleas and also bits of vegetation or the insects attached to the vegetation as was revealed by stomach contents.
8. It has been found breeding in Kashmir from the beginning of May to September, i.e., for 5 months. It appears that the breeding season is very lengthy and different fishes breed at different times of the season. I have not been able to find out yet if one fish breeds more than once, which I doubt very much.'

It is known that the same pair of *Gambusia* will breed once in about three months. It would seem probable, therefore, that the same pair may breed twice or even thrice during the five favourable months from May to September in the Kashmir Valley.

In the Mysore State, *Gambusia* was introduced for the control of mosquitoes but it has now become fully acclimatised to natural waters and breeds prolifically. It is found in such great abundance in the State that it is now sold in heaps as dried fish on road sides (*vide* Bhimachar, 1942, p. 29). Though in the Kashmir Valley no local name has yet been assigned to it, in a few years this fish is likely to become very abundant and may form a fishery as in the Mysore State.

In February-March 1920, the writer surveyed extensively the fauna of the Manipur Valley in Assam and wrote a report on the fish and fisheries of the Valley (Hora, 1921). In February 1953, another visit was paid to the Valley (Menon, 1954) and to the writer's great surprise the principal fish in the market at Imphal was the famous *Koi* fish of Bengal, *Anabas testudineus* (Bloch), the so-called Climbing Perch. This fish is now most abundant all over the Valley, particularly in the Logtak Lake, while in 1920 it was totally absent from the Valley. Two other species of fish, *Colisa fasciata* (Bloch) and *C. chuna* (Hamilton), were non-existent in the Valley during 1920, but now form commercial fisheries as dried and smoked fish. Similarly, another new introduction in the valley is *Ophicephalus striatus* Bloch, a commercial fish of some importance in certain parts of Peninsular India.

Fortunately, in the case of the Manipur Valley it is known that these fishes were introduced about 1930-31 by Raja Dumbra Singh, paternal uncle of the present Maharaja. We were informed that within a period of six to seven years after introduction, these became available in abundance in the Valley. All these species normally inhabit warm waters, but now they have become fully acclimatised to the cold waters of the Valley. We were informed that *Anabas*, during severe cold, lies along the edges of the lake in a state of torpor when it can easily be picked up with hands. The behaviour and life histories of these familiar tropical Indian fishes under changed ecological conditions of the Manipur Valley are worth investigation.

ZOOLOGICAL SURVEY OF INDIA,
34, CHITTARANJAN AVENUE,
CALCUTTA, S. L. HORA
*March* 24, 1955.

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## 18. SOME INTERESTING FEATURES OF THE AQUATIC FAUNA OF THE KASHMIR VALLEY[1]

### I. INTRODUCTION

Despite the highly interesting ecological and geographical features of the Kashmir Valley, its fauna has been very inadequately explored. The present article is based on the information collected about the aquatic fauna by two short faunistic surveys conducted by small parties of the Zoological Survey of India during May-July 1921 and May-June, 1954. As was expected, even a superficial analysis of the data collected has yielded very useful information regarding faunal characteristics of the Kashmir Valley. It is hoped that a more extensive and critical study of the fauna, which is now under way in the Zoological Survey of India, will prove to be helpful in developing the fishery resources of the Valley.

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[1] Read at the 42nd Session of the Indian Science Congress held at Baroda in January 1955.

## II. ENVIRONMENTAL CHARACTERS

The Valley of Kashmir is situated amidst the snowy ranges of the Western Himalayas. It is about eighty miles long, about twenty to twenty-five miles broad, and on the average rising about 6,000 ft. above sea level. It is flanked almost on all sides by snow-capped mountains. The Jhelum River which originates in its south-eastern corner traverses its whole length and is supplied by several spring-fed and snow-fed streams as well as by its all great water reservoirs, the most important of which are the Wular, the Dal, and the Manasbal lakes. It finally flows down to Pakistan from the western side of the Valley. Down the mountain slopes, numerous hill-streams tumble down into the Valley where they are received and silenced by the vast and calm waters, expanses of the Jhelum drainage system.

The mean temperature at Srinagar varies from 35° to 95° F. and the total annual rainfall at the same station is about 26.7 inches.

The Kashmir Valley is blessed with a rich flora much of which is peculiar to it. The mountains are clad with fine forests chiefly of pine and fir, while on the plain, the willow, the poplar, numerous fruit trees of finest kind, and other flowering plants abound. The aquatic vegetation, wherever water is somewhat stagnant, is also abundant. The principal aquatic plants met with are *Hydrilla*, *Crispa*, *Nelumbium*, *Potomegeton*, *Spirogyra* and others.

## III. GENERAL FEATURES OF THE FAUNA

On the basis of its faunistic characteristics, the Jhelum catchment system can very conveniently be divided into two categories: (i) The Jhelum River itself and the various lakes and springs pouring into it from all sides. These waters are characterized by slow current, comparatively high temperature, and generally by the presence of sufficient aquatic vegetation; (ii) The snow-fed torrential mountain-streams with icy-cold current of water flowing over boulders and stones. Except a few minute Thallophytes, these streams are generally devoid of any vegetation.

The first category has its characteristic fauna consisting of planarians, leeches, the Amphipod *Gammarus*, water beetles, water skaters, bugs, several kinds of insect larvae and nymphs, molluscs, a number of Schizothoracine fishes, and frogs. The most striking feature of this fauna is that almost all forms are widely distributed in the Valley owing to the continuity of and similarity of the Jhelum drainage waters.

In the second category comprising mountain-streams, the fauna is scanty but very different from that included in the first category. It includes the characteristic mountain-stream fishes (*Oreinus*, *Glyptothorax*, *Glyptosternum* and *Nemachilus*), Blapherocerid larvae, larvae and nymphs of Mayflies and Caddisflies which by virtue of their suckers and other adhering adaptations can admirably withstand torrential currents. The amphipod *Gammarus* is also found in clear waters of mountain-streams.

As will be apparent to any collector, the variety in the fauna is poor but this is compensated by each form being represented by large populations. The chief reason for this phenomenon appears to be the rigours of the climate which only a few species have been able to cope with; but once this hurdle had been crossed the species have flourished abundantly; the lack of competition and of enemies accelerating the process. Isolation of the Valley by formidable physical barriers has contributed to the high endemicity among the species of the Valley.

Though most of the species are of Central Asiatic origin, some hill-stream fishes of the Indian plains have been able to colonise the Valley *via* the route provided by the Jhelum River.

Introduction of exotic species appears to be rare, but one notable instance is that of the Central American larvivorous fish, *Gambusia*, which has shown remarkable adaptive capabilities to an environment very different from that of its homeland. The fish, however, is reported to withstand great variations in temperature even in its original habitat.

## IV. GROUP BY GROUP NOTES AND OBSERVATIONS

*Porifera.*—A few specimens were found encrusting weeds and pieces of wood in the Dal lake.

*Platyhelminthes.*—Planarians were commonly found sticking to the stones or crawling on the muddy bottoms of springs and their outlets. Cestodes, Nematodes and Acanthocephala were commonly met with in the intestines of Schizothoracine fishes. The infection was approximately 50%.

*Annelida*—Aquatic leeches were very common in all parts of the Valley. Some of them parasitized fishes.

Among the 12 species of leeches known from the Valley, the Palæarctic element predominates and there are some polytyptic species among them.

*Crustacea*—A species of *Gammarus*, Palæarctic in origin, was perhaps the most abundant species, occurring in large numbers in all types of habitats. It forms an important item of the food of fishes. It is noteworthy that no Decapod Crustaceans are so far known from the Valley.

*Apus cancriformis*, locally known as *Dadar*, *Dadao*, and *Pahar*, is met with in paddy fields. It is considered to be a pest of the paddy. This species has got a wide distribution in other parts of the world and is notable for its sporadic occurrence and sudden appearance and disappearance.

*Insecta*—Aquatic Coleoptera and Hemiptera are very common. Several kinds of insect larvae and nymphs are also met with in great numbers. The latter form an important source of the food of fishes.

*Mollusca*—Various species of *Lymnæa* are abundant. One species of *Corbicula* is found in the lakes. Besides *Succinea*, *Indoplanorbis*, *Bithynia*, *Valvata*, and *Gyraulus*, are also found here and there in small numbers.

Of the twenty-two species and varieties of aquatic molluscs known from the Valley, 7 are endemic, 9 Palæarctic and 6 Oriental. The endemic species are of Palæarctic origin showing thereby the great preponderance of the Palæarctic element in the fauna.

*Pisces*—There are about seventeen species of fish found in the Valley. Of these, 9 are of Central Asiatic origin, 7 of Indian origin, and one introduced.

*Amphibia*—Frogs (*Rana limnocharis* and *R. cyanophlyctis*) are very common. Their use as important fish food in trout farms has been suggested to the fishery authorities.

### V. CONCLUDING REMARKS

The foregoing bird's-eye view of the fauna of Kashmir has brought to light some interesting ecological problems which can very profitably be tackled in the Kashmir Valley. The highly adapted hill-stream fishes are sometimes suddenly washed down into almost stagnant waters of the lakes. The recent zoological survey obtained a number of such strayed individuals in the Wular Lake. It will be an interesting study to know how a naturally induced sudden change of habitat affects the life of such fishes. A detailed comparison of the fauna of Kashmir with those of the adjoining geographical tracts is bound to throw a flood of light on the problems of adaptation, speciation and zoogeography.

As the approximate time when the Valley became isolated in its present form is known as five lakh years, it may be possible to work out the rate of speciation to a fairly accurate degree.

Lastly, the potentialities of Kashmir Valley for fishery development cannot be overemphasized. The presence of vast water reservoirs ideally suited for fish breeding, of many delicious species of fish, and a great demand for fish among the population cannot but bring home the urgent need for the development of fisheries in the Valley.

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA,
*March* 24, 1955.

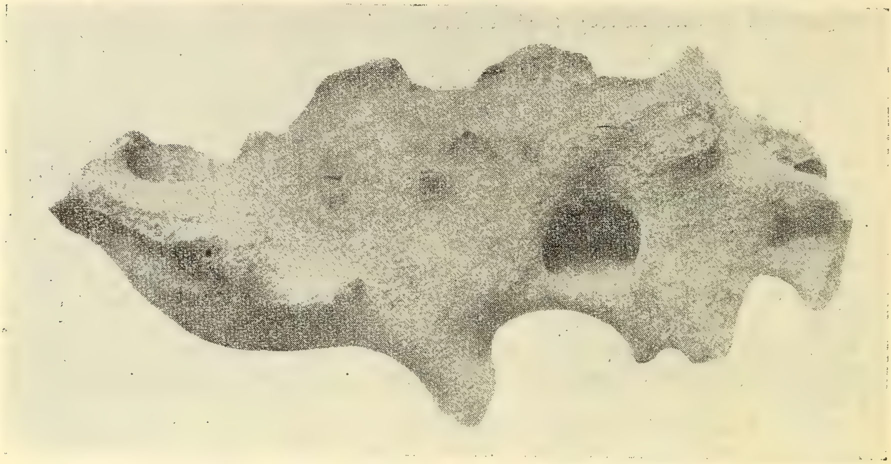
S. L. HORA
G. M. MULIK
H. KHAJURIA

## 19. THE ROYAL CELLS OF THE TERMITE *ODONTOTERMES OBESUS* WITH UNUSUALLY LARGE OPENINGS

(*With one photo*)

Royal cells of the termite *Odontotermes obesus* are made of hard clayey material. Their walls may be thin or thick and are occasionally traversed by roots of the trees against which the mounds of this termite are often constructed. The royal cells usually possess a few small holes in their walls. These tiny holes allow passage for the workers and soldiers but at the same time they are too narrow for any transit of the royal pair.

Certain mounds of this termite were dug out in June 1954 (Loc. Dhampur, West U.P.) and one of them showed an interesting condition. It had two royal cells: one situated at about ground level and the other about 4 inches below the first. Besides the usual tiny holes, walls of each of these royal cells contained one exceptionally large opening. It established a communication between the interior of the royal chamber and the outside. In each cell the opening was 1.5 cm. wide and thus it was large enough for any transit of the queen. As expected, both these royal cells were found to be empty. A normal queen was recovered from a deeper level.



Royal cell of *Odontotermes obesus*, lateral view, showing an unusually large opening × $\frac{3}{4}$ (approx.)

It is suggestive from the above, that the queen in this case had been changing her position in the nest. A large hole was made each time in the walls of the royal cell to enable her to be taken out and transported to the new site by other members of the colony. A possibility of such transportation of queen has previously been expressed by Mukerji and Raychaudhuri (1942) in respect of *O. redemanni.*

DEPT. OF ZOOLOGY,
UNIVERSITY OF DELHI,
*May* 14, 1955.

H. S. VISHNOI

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## 20. THE BUTTERFLY *THECLA TRILOKA* HANNYNGTON (LEPIDOPTERA—LYCAENIDAE)

In 1910 there was published in *Journ. Bom. Nat. Hist. Soc.*, Volume XX, 'The Butterflies of Kumaun' by F. Hannyngton, who on page 367 described as a new species *Zephyrus* (now *Thecla*) *triloka*, based on 3 females obtained in August in the Pindari Valley, Kumaun.

In 1911 Swinhoe in Lepidoptera Indica, volume 8, page 260, stated: '*Zephyrus triloka* (sic) Hannyngton, whose type he has kindly allowed us to examine is undoubtedly only a dry form of the female of *Ruralis* (now *Thecla*) *syla* Kollar'. Subsequent authors, following on Swinhoe's determination, have placed *triloka* as a synonym of *syla*, which is a common Himalayan species. Hannyngton died in 1919 and his collection was acquired by Lord Rothschild for the Tring Museum.

In 1954 T. G. Howarth of the British Museum (Natural History) was called upon to name a large collection of Chinese Lycaenidae. For the difficult genus *Thecla* he found it necessary to carry out a detailed examination of all the material available and specimens from Tring were amalgamated with the general collection in London. In addition to the 3 females mentioned by Hannyngton, 2 males were found labelled respectively 'Kumaun Aug. Coll. Hannyngton' and 'C. Kumaun, E. Ramganga Valley, Quanti, 5,000 ft., H. G. Champion: June 1924.' Superficially, as well as in the form of genitalia, *triloka* was found to be a distinct species with no near ally. The upperside of the male resembles *syla*, but on the underside *triloka* is quite distinct, as described by Hannyngton.

I publish this note, with the consent of Mr. Howarth, in order to justify the judgement of my friend F. Hannyngton.

BRITISH MUSEUM (NATURAL HISTORY),
LONDON, W. H. EVANS
*March* 26, 1955.

## 21. ADAPTIVE COLORATION AND CAMOUFLAGE OF THE COMMON MEMBRACID ('TREE-HOPPER') *OTINOTUS ONERATUS* WALK. (HOMOPTERA: RHYNCHOTA)[1]

The common membracid *Otinotus oneratus* Walk. infests a large number of plants belonging to various natural orders in Orissa, Bengal and Bihar (Behura, 1951; Behura & Sinha, 1951). During June to October and sometimes till early November, the nymphal stages of *O. oneratus* occur in plenty and the feeding and mating activities reach their zenith at this period. The membracid is closely attended by the common ant *Camponotus* (*Tanaemyrmex*) compressus Latr., which relishes its anal excretions.

From late November to the beginning of March, that is, during the winter season till the advent of hot summer weather, the membracids are not usually attended by the ants and the nymphal stages are rarely seen during this period, though the adults persist. The general coloration of the mature form shows cryptic coloration with the twig and the spiny pronotal processes of the membracid as the insect rests on the axils of plants appear like thorns or some spiny projections or some other structures of the host-plants. It is interesting to point out that heightening of cryptic resemblance occurs when the ants are not in attendance, and the dense brown colour of the body, wings and the pronotal processes acquires the distinct pale tawny colour of twigs, drying thorns or other processes of the host-plants.

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[1] The note was presented to the Indian Science Congress, Baroda, 1955 and an abstract appeared in the *Proc. 42nd Ind. Sc. Cong.* (3): 291.

Ayyar (1935) in South India observed that the activities of the ant, *C. compressus* were at a minimum during the period from late November to March. The rhythmic activity of the ant, therefore, appeared to have its effect on the seasonal history of its ant cattle *O. oneratus*, as indicated by the change of colour of the membracids with the non-attendance of ants.

In order to determine whether the change of coloration in *O. oneratus* is due to the non-attendance of the ant *C. compressus*, the membracids were isolated from the group where the ants were associated with them, but no remarkable change in the coloration of the membracids was noticed after separation. It would therefore appear, that the change in coloration is cryptic and is not at all dependent on the attendance and non-attendance of the ant *C. compressus*, and the correlation beween colour changes in the membracid and the seasonal history of its attending ant is merely a matter of coincidence. During winter, when the host-plants assume a rugged appearance, the colour of the membracids changes in accordance with the coloration of the host-plants, and incidentally they are not then attended by the ants.

Poulton (1903) in Buckton's monograph of Membracids on 'Suggestions as to the meaning of the shapes and colour of the Membracidæ in the struggle for existence' stated that in the Membracidæ the disguise is chiefly borne by the pronotum alone and the likeness to plant structures is for the purpose of concealment. However, he stated that direct evidence was lacking as to the change of colour in the Membracidæ in accordance with two or more environments. It is interesting that Poulton's remark now finds its support from *O. oneratus*. The coloration of this membracid species is cryptic, and it is a matter of coincidence that the change of colour is so marked when the attending ants are absent.

The author's grateful thanks are due to Prof. Julian Huxley, F.R.S., for kindly going through the manuscript and offering helpful suggestions, and to Mr. D. Mukerji, Department of Zoology, University College of Science, Calcutta University, for his kind help in the preparation of the manuscript.

DEPARTMENT OF ZOOLOGY,
RAVENSHAW COLLEGE,
CUTTACK,
*February* 3, 1955.

BASANTA KUMAR BEHURA

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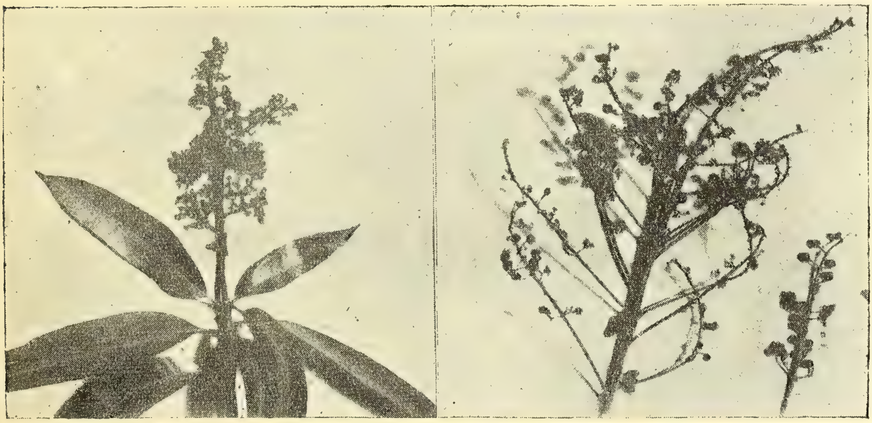
Poulton in Buckton, G. B. (1903): A Monograph of the Membracidæ: 275-276.

## 22. INCIDENCE OF MANGO FLOWER GALLS IN BOMBAY KARNATAK

(*With a photo*)

A number of gall-forming insects have been recorded previously on *Mangifera indica* Linn. in various parts of the world. However, very few of them have been observed as serious pests. In Bombay State, with the exception of the Cecidomyiid flies—*Allasomyia tenuispatha*—noted by the author as a serious pest of mango, practically no information exists about the fauna of other gall-forming insects of serious importance. During January and February 1954, at Dharwar, in Bombay Karnatak another gall fly *Dasyneura mangiferae* Felt. was noted for the first time, infesting the mango flower buds to an extent of 80 to 90% in a single inflorescence. The infested flower bud instead of developing in a normal way, presented a characteristic gall-like swelling. The dimensions of such galls varied from 0.3 x 0.4 mm. to 0.32 x 0.45 mm. As the size of the galls increased, the larvae contained within them reached maturity. Pupation was noticed within the gall in white silken cocoons. The adult flies finally emerged through an apical opening from the gall.



EARLY STAGE LATE STAGE

Infestation by *Dasyneura mangifera*

Life-history—The insects oviposited in the individual unopened flowers just after their emergence. On the 4th day only the healthy flowers opened, whereas the infested ones swelled into small peanut-sized galls. On opening the individual galls, in each of them one to four cream yellow coloured larvae were noticed. Each full-grown larva was spindle-shaped and measured on an average 0.20 mm. to 0.25 mm. The average of 36 rearings conducted from egg to adult in the laboratory indicated that larval period ranged between 6 to 9 days. The well-developed pupa showed yellowish brown to dark brown coloration prior to hatching. The pupae invariably developed within white papery silken cocoons. The adult insects emerged after a period of two to three days in the laboratory rearings. The newly-emerged adults measured on an average 0.40 mm. in length and 0.50 mm. across wings; with 15 segmented antennae and 4 segmented tarsae. The duration of the life cycle of the insect in the laboratory was found to range from 8 to 11 days.

These observations were also confirmed in the field during investigations lasting from 10th December 1953 to 23rd January 1954. During this period there were successive emergences of the insect which continued to infest the mango inflorescence on a considerable scale, thus affecting the bearing of the crop. Before working on the control of the insect, alternative host plants will have to be experimented with. The investigations are in progress and the details will be published as they are completed.

ENTOMOLOGICAL LABORATORY,
COLLEGE OF AGRICULTURE, H. L. KULKARNY
DHARWAR,
*January* 15, 1954.

## 23. SWARMING OF LONG-HORNED GRASSHOPPERS (*MECAPODA ELONGATA*)

On the 29th October 1954, while driving home from the city to Bandra at about 7 p.m. I saw large numbers (30-50) of *Mecapoda elongata* at each of the street lights, about 15, from the top of Cumballa Hill down to Hornby Vellard. They were also present in smaller numbers at occasional lights further northwards to Bandra. During the previous week, a few had entered my house at Bandra at night and several other people had reported similar insects entering their homes in and around Bombay.

The Zoological Survey of India to whom a specimen was sent for confirmation of identity state that this species has not been known to swarm, and this occurrence therefore seems worth recording.

On the night of 18th October while looking for frogs at Matheran (2,000 ft.) I had heard a long strident call and traced it down to one of these insects on a bush under trees about 2 ft. above ground. This may of course have no connection with the swarming.

c/o FAIZ & CO.,
75 ABDUL REHMAN STREET,
BOMBAY, HUMAYUN ABDULALI
*December* 18, 1954.

## 24. LEECHES

I found the letters on leeches in your August-December issue most interesting. I cannot claim to have had long experience of these unpleasant creatures, but a few observations made in Nepal during 1952 and 1954 may be of interest. I was primarily engaged in collecting plants west and south of the great Dhaulagiri range in that country. The heavy rainfall which is precipitated on the southern flank of the range provides very suitable country for leeches to thrive in.

Two types of leech were encountered. The commonest type, which seems to correspond with the species *Haemadipsa montana* mentioned by J. L. Harrison had a very wide distribution and the vertical range was especially interesting. I found this type at 3,000 ft. which seemed more or less to constitute its lower limit, in the evergreen *Castanopsis* and *Schima* forests near the Kali Gandak River. Here a few leeches were active before the monsoon, and I was bitten in mid-April. Later they were abundant and were still active in November when I left. The other end of their altitudinal range I found was about 13,000 ft., and it came as an unpleasant surprise to have hands bitten while collecting primulas, meconopsis, potentillas, etc. in the beautiful alpine meadows. Of course the season of activity here is much shorter since the ground is frozen from October to April or May.

The most important point concerning their presence, i.e., their relative abundance or not, is, I feel intimately linked with the passage of domesticated cows, buffaloes, sheep and goats. In Central Nepal at least it seems that their distribution is dependent upon these animals. It was a familiar sight to follow a blood-stained goat track up to an alpine grazing encampment, and this leech was especially given to hiding under stones in the track and around the grazing sites. I found that if one strayed well away from the track, leeches were usually markedly fewer in number, and I was particularly interested to observe that in some cases where domesticated animals either did not use the track, or used it only in the winter months, leeches were almost absent. Above one Nepali hillside village at 8,500 ft. leeches were abundant on many of the grazed slopes, and especially frequented the densely forested ravines. Yet below the village in very moist *Tsuga* and *Quercus* forest leading down to the river bed, there were practically no leeches on the tracks and in the clearings. I was most surprised at first, since this was in the middle of the monsoon, but my Lepcha collector said that the cattle and goats only came down in the winter months when the grazings above were frozen and snow covered.

The question of overwintering is very interesting, especially at the higher altitudes. While it has occurred to me that in their uppermost limits they may die out each year, the population being renewed by the upward passage of animals in the following season, I certainly found in at least one grazing site at 11,000 ft. very active leeches in early June before any herds had arrived. I must admit that I failed to find these leeches in late October when bitter frosts were occurring, and I considered that they must descend quite deeply into the soil to hibernate. One incident linked with this question happened when I was encamped in a forest clearing at 10,500 ft. in late September. A number of leeches came into my tent at night, a most unusual occurrence with this species (I normally used a waterproof groundsheet). They were, however, not interested in me for a change, and upon inspection they seemed to be gorged or partly gorged leeches, which I rightly or wrongly assumed were trying to find a place to hibernate in.

The problem of the time which elapses between one blood meal and the next raises itself, and I think that in Nepal at any rate the five months suggested by J. L. Harrison must be extended in many cases to at least ten months, and it appears that in the higher regions that length of time would be usual. Incidentally I saw nothing to suggest that anything other than blood was consumed. Also I do not feel that wild animals play an important part in their distribution, since the population of mammals in the upper forests at least does not seem very high. I never saw this leech attempting to climb anything but the lowest herbs, and it always attacked near ground level.

The other type I encountered was a rather larger creature of a lighter brown colour with a yellow dorsal stripe, which we called the 'tree' leech to distinguish it from the previous type. In spite of its definite climbing habits I agree with your other correspondents in that I never saw them drop from above, and the odd occasions when a gorged brute fell from my head was I am sure due to brushing against shrubs. Their sense of smell seemed almost uncanny when one's presence was noticed from a yard or two away.

I found it quite noticeable that this type did not really make its appearance in strength until the monsoon was well under way, about the end of July. Then by the end of September they had disappeared. When the weather was fine they were not troublesome except in very damp and shady ravines, but when it was raining they ascended the tall herbs and shrubs in very large numbers, so that on a narrow track it was almost impossible to avoid getting bitten. I well remember sheltering in a herdsman's shack from a particularly heavy downpour one day, when a buffalo and its calf also came along with the owner. The poor beasts were covered with 'tree' leeches, even into their eyes, and one realised what a menace they could be. This leech had a much more restricted range and I only found it between 5,000 ft. and 8,000 ft. in the wettest areas immediately south of the Dhaulagiri range. The two types inhabited the same country, although where the 'tree' leech was abundant there seemed to be fewer of the other.

To combat these creatures, i.e., mainly the ground frequenting type, I used dried tobacco leaves wrapped in my socks, and found that with puttees on I could remain reasonably free from attack. The styptic pencil I carried with me would seldom satisfactorily staunch the flow of blood from a 'good' bite. The local people who went barefoot were often bitten, and it was quite a usual sight to have my coolies come into camp with legs streaming blood. They used to often spit the juice from tobacco leaves on to the leeches, to which they were undoubtedly very susceptible.

I have been told that one should never pull leeches off, but I confess I again followed the example of the local people and my Lepcha who always pulled them off. Incidentally I observed that the 'tree' leech had a larger sucker and was more difficult to get rid of. However, unlike Col. F. M. Bailey, I have fortunately never had a bite fester, even coming down to the Indian border in rather poor condition in 1952. Also I have never noticed any irritation resulting from a leech bite.

In conclusion I should like to state that I make no claim to have solved the problems concerning leeches, for my observations have been over a very limited time, and confined to a particular area where special geographical features occur.

ROYAL HORTICULTURAL SOCIETY'S GARDENS,
WISLEY, RIPLEY,
WOKING, SURREY,
*March* 28, 1955.

W. R. SYKES

## 25. OCCURRENCE OF THE FRESHWATER MEDUSAE, *LIMNOCNIDA INDICA* ANNANDALE, IN THUNGA RIVER NEAR SHIMOGA TOWN, MYSORE STATE

A survey of the fisheries, between Thunga anicut and Shimoga town (a distance of 7 miles) was being conducted in the month of March, 1954. On March 26th, 1954, a pool in Thunga River near Arkere which is 3 miles from Shimoga town was seen to contain swarms of freshwater medusae. This being significant, series of observations were made in the pool from 26th March 1954 to 7th June 1954.

The pool has a sandy bed with rocks on one side and is 150 ft. long, 50 ft. wide and 6½ ft. deep, there was a small flow of water from the main stream at one end and a little overflow at the opposite end. The water in the pool was still and had a clarity of 2 ft., the colour of the water was generally light green. There was no aquatic vegetation except for a few submerged shrubs. Small fishes like *Rasbora*, *Danio*, *Barilius*, *Ambassis* and *Chela* were found in the pool. The water temperature was observed from March to June, 1954 and it ranged from 29.0°C. to 34.0°C. The medusae were visible at the surface on days when the water temperature was 30.0°C. and below. On hotter days, the medusae were mostly at the bottom.

Again on 25th Feb. 1955, the medusae reappeared in the same pool after a lapse of seven months.

H. S. Rao (1932)[1] mentions his unsuccessful attempt to locate freshwater medusae in Thunga and Bhadra rivers and P. A. Ramakrishna (1950)[2] while recording the occurrence of freshwater medusae in the Sharavathi river, raises a point about the occurrence of the medusae in the same pool year after year. The occurrence of the freshwater medusae in Thunga River and their recurring appearance in one and same pool in successive years is significant. The medusae are washed away with the floods and die, while the eggs, they have left behind in the pools develop and reappear as medusae in the subsequent season.

Fisheries Section,
Department of Animal Husbandry Services,
Government of Mysore,
Bangalore.

H. D. R. IYENGAR
K. VENKATESH

## 26. A NEW WEED FOR CEYLON

On my way back from Djakarta I stopped at Colombo for a few hours, and noticed a conspicuous white flower scattered over the grassy area in front of the Colombo Club and the Galle Face Hotel. I do not remember seeing the plant when I was last in Colombo 25 years ago, and it turns out to be *Gomphrena celosioides* Mart. This species is a native of S. Brazil and Argentina; it has been recorded from Africa, India (Dehra Dun and Madras), Malaysia, and Australia as an introduced weed. It is the *G. decumbens* of Gamble's Flora of Madras. Probably it will be found elsewhere in Tropical Asia. The specimen is in the herbarium of the British Museum (Natural History).

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[1] Rao, H. S. (1932): *JBNHS*, **36**, (1); 210-217.

[2] Ramakrishna, P. A., *et al.* (1950): *JBNHS*, **49**, (2), 318-319.

A. H. G. ALSTON

[*Gomphrena celosioides* is a plant of recent introduction into India, but in a short time it has managed to spread very widely almost all over the country. We have seen it in various parts of Bombay and Saurashtra, usually along the main roads or on railway lines.—Eds.]

## 27. A NOTE ON THE FLORA OF MIRZAPUR (U.P.)

Hooker, Duthie, Raizada and Bor studied the flora of Uttar Pradesh in general, but it appears that the Mirzapur district which has a large hilly area, a continuation of the Vindhyan Range, bearing forest of all classes, has not been intensively botanized.

Winds, rain and man play an important role in the distribution of plants to long distances, so that, Mirzapur being surrounded by Bihar in the east, Madhya Pradesh in the south, and Vindhya Pradesh in the west, should show an admixture of the flora of these provinces with those of U.P. The author's study of the flora of this district does indicate such admixture. Many such plants have been collected which are not reported from any part of the Uttar Pradesh, even from the nearby districts of Allahabad (G. D. Srivastava, 1938) or Benares (Misra, 1944 and 1946), but they are known to occur in the neighbouring states.

The list of these plants is as follows:—

*Alternanthera echinata* Sm (Amarantaceae)
*Athroisma laciniatum* DC (Compositae)
*Blumea Jacquemontii* Hook. f. (Compositae)
*Bulbostylis capillaris* Kunth (Cyperacae)
*Convolvulus microphllus* Sieb (Convolvulaceae)
**Dimeria connivens* Hack (Gramineae)
*Dopatrium junceum* Buch-Ham (Scrophulariaceae)
*Eragrostis rupestris* Steud (Gramineae)
*Gomphrena celosioides* Mart. (Amarantaceae)
*Lepidagathis trinervis* Nees (Acanthaceae)
*Lindernia multiflora* (Roxb.) Mukerjee (Scrophulariaceae)
*Lindernia verbenaefolia* (Colms) Pennell (Scrophulariaceae)
*Luffa graveolens* Roxb (Cucurbitaceae)
*Microcarpaea muscosa* R. Br. (Scrophulariaceae)
**Pennisetum pedicellatum* Trin (Gramineae)
**Pseudoraphis aspera* (Koen) Pilger (Gramineae)
*Vicoa cernua* Dalz (Compositae)

The author is very grateful to Prof. K. N. Kaul, Director, National Botanical Gardens, Lucknow, for providing facilities for work; to

Dr. D. Chatterji, Systematic Botanist, I.A.R.I., New Delhi, for suggesting many improvements in the MSS. and to Dr. S. K. Mukerji, Curator, Indian Botanic Gardens, Calcutta, for identifying many of the specimens.

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NATIONAL BOTANICAL GARDENS,
LUCKNOW,
*March* 21, 1955. J. G. SRIVASTAVA

Species marked with an asterisk * have very recently been reported by Raizada, M. B. (Grasses of the Upper Gangetic Plain) in the *Indian Forest Records*, **4** (5), 1954.

## 28. SOME EDIBLE AND MEDICINAL PLANTS FROM EAST NEPAL

During my five visits to East Nepal I have come across many medicinal plants. Of most of them, the medicinal properties are well known; but there have been some that are used by the local inhabitants, and I have not been able to find reference to them in the standard books. I have also on record some plants that are edible and are quite frequently used. Below is the list of such plants:—

*Cerastium vulgatum* L. (Caryophyllaceae)

A very common herb ascending up to 12,000 ft.

A little decoction of the plant is said to relieve headache.

*Ephedra gerardiana* (Wall.) Stapf.var. *sikkimensis* (Stapf.) R. Florin.

A small rigid shrub growing abundantly in exposed places, especially on shingly slopes from 12,500 ft. to 16,000 ft. It is most abundant in Namchebazar area.

The sherpas drink a little of hot decoction in cases of acute bronchial congestion. This shows that the plants have some ephedrine contents.

*Geranium nepalensis* Sweet. (Geraniaceae)

A perennial herb abundant between 5 and 9,000 ft. all over East Nepal.

I have often seen my porters chew the roots, particularly after long marches. It can either be as a tonic or to flush the urinary system.

*Meconopsis nepalensis* DC. (Papaveraceae)

Abundant between 10-12,000 ft. Stem about 3 ft.; young parts densely covered with golden hairs. Flowers yellow. I have noticed the species to be very common in Topke Gola area, and Panch Pokhri and Jata Pokhri area (above Thosē). The rhizomatous portion after peeling the outer rind is eaten. I have seen my sherpa porters digging up the underground portion and eating it raw. On tasting, I found it to be sweet and very much like *Pachyrhizus angulatus* Richb. I have also been reliably informed that the herdsmen eat plenty of it when in camp.

*Myrica nagi* Thunbg. (Myricaceae)

A small tree with beautiful reddish drupes and known as 'Kaiphal' or 'Kaphal' by the Nepalese.

The plant is of great medicinal value. The powdered bark is most commonly used as a snuff to relieve headache and nasal congestion. It is also used in amenorrhoea. The headman of Thosē informed me that the plants were in abundance in earlier days; but now the plant is scarcely met with in East Nepal. I have seen some above Lebang village (*en route* to Topke Gola.)

*Oleandra wallichii* Persl. (Filicales—Davalliaceae)

An epiphytic fern commonly met with.

The rhizome is said to be of medicinal value. According to the headman of Thosē the rhizome is beneficial to the aged. I presume that it is a rejuvenator just as *Lycopodium*, which has an important place as a rejuvenator in the homeopathic system.

*Polygonum molle* D. Don. (Polygonaceae)

A large trailing shrub known as 'Thotna' also as 'Patu soa'. Noticed to be abundant in all the valleys of East Nepal and growing in shady places.

In 1952, after our descent from the perpetual snow, I found my porters eating the tender branches. They explained that the digestion which gets upset in the cold is remedied by the juice. Also, when one suffers from diarrhoea 'thotna' is often given.

*Prasiola fluviatalis* (Ulotrichales—Prasiolinae)

Reported to be occurring in the cold streams towards Godavari in Nepal.

Dried masses are sold in Kathmandu. A curry which is much relished is prepared of this alga.

*Rhus parviflora* Roxb. (Anacardiacae)

A shrub of very common occurrence along the dry slopes. At about 2,500 ft. open scrubs of *Rhus* are mostly seen.

The fruits are sold in Kathmandu and in the weekly markets in the interior. Fresh or dried fruits known as 'Sati bair' are eaten. It is said that the fruit juice is a vermifuge.

*Sambucus adnata* Wall. (Caprifoliaceae)

A plant which has been introduced and has well established itself in Kathmandu Valley. Abundant in the interior.

Shrub of 4-8 ft. in height with white flowers in corymbs.

The tender branches are cooked and a pickle is also made out of it. The curry and the pickle was tasted in a sherpa home and was found to be of exquisite taste. The sherpas seem to hold the preparations as delicacies.

*Thermopsis barbata* Royle. (Leguminosae)

Another common herb of the temperate and sub-alpine zone. The young rootstock and the branches are edible.

*Valeriana wallichii* DC. (Valerianaceae)

A herb found at 5-7,000 ft. Rootstock aromatic. Collected by me from Chandragiri and Bhitrikhani (Thosē to Ramechap) I have been told that after childbirth a decoction is given to the mother. Is it to sooth the nerves?

*Zanthoxylum hamiltonianum* Wall. (Rutaceae)

A scandent shrub known as 'Purpura Timur' or 'Timur' and also as 'Nepali Dhania'. Occasionally found by me in the forests between Dhankuta and Chainpur (Tinjura); Dingla and Bhojpur (Ghorebisa) and around Papung (Topke Gola side). At Papung in 1953 Mrs. Banerji, who had developed acute stomach trouble, was given powdered seeds of this plant by the hostess. The first dose showed signs of effect and after two more doses the trouble was no more. A spice is also prepared by crushing the fruits along with the seeds and mixing in it a little of red chillies and salt. I can say from my experience that it tastes well with 'dal' or even with rice. The various species of *Zanthoxylum* are commonly known as 'Timur'.

I am indebted to U.P. Research Committee for partly financing the tours of 1952, 1953 and 1954; and to Fr. H. Santapau for his valuable suggestions and useful criticisms.

BOTANY DEPARTMENT,
MEERUT COLLEGE,
MEERUT. (U.P.) M. L. BANERJI

## 29. AN ABNORMAL CONDITION OF FRUITING IN BANANA

In Banana (*Musa sapientum* Linn.) the stem is a pseudo-stem composed of the convolute leaf sheaths. The inflorescence which is a spike arises from the rhizome, and is pushed up through the centre of the pseudo-stem until it emerges from the top near the base of the spirally arranged leaves.

Recently at Lucknow a plant was noticed with a spike bursting from the middle of the pseudo-stem (about 8 ft. high) at a height of about 2½ ft. from the ground. The ruptured place from where the spike came out had a rotten appearance. The plant was growing in a thick banana clump and was a rather unhealthy specimen.

This abnormal condition probably occurred because of check in the growth of the spike from reaching the top of the pseudo-stem.

BOTANY LABORATORY,
NATIONAL BOTANICAL GARDENS,
LUCKNOW,
*February* 5, 1955.

G. S. SRIVASTAVA

## 30. ABNORMAL BRANCHING AND FASCIATION OF THE INFLORESCENCE AXIS IN *MUSA PARADISIACA* LINN.

(*With a plate*)

In the early stages, at the time of emergence through the false stem, the inflorescence was normal with a single 'flower' at the tip. After giving 5 hands of fruits branching of the tip was noticed. One of the three 'flowers' at the tip and the individual flowers in it are slightly abnormal in shape. This is probably due to an abnormal branching of the growing point of the inflorescence axis brought about as a result of proliferation. The 'flower' showing marked fasciation is more or less rounded and easily distinguished from the others.

Of the three 'flowers' at the tip one was sterile as in the normal case. The other two additional inflorescences bore only pistilate flowers and all of them matured into fruits. These two are not terminated by sterile flowers as in normal cases. The fruits are very close and crowded.

GOVERNMENT ARTS COLLEGE,
MOUNT ROAD, MADRAS,
*February* 22, 1955.

R. RAMASWAMI

## 31. *LAURENTIA LONGIFLORA* ENDL., A NEW RECORD FOR BOMBAY STATE

(*With a plate*)

Two or three years ago a friend gave me a plant that he had discovered growing accidentally in his garden in Bombay; in October 1953 I found the same plant growing in waste lands near the railway station at Castle Rock in North Kanara. The plant was identified at the time as *Isotoma longiflora* Presl. This is a new record for Bombay. As it may be of interest for other botanists, I have taken the description of the same from the recently published monograph of Wimmer in *Pflanzenreich*, vol. 107; the description is herewith given translated from the Latin of Wimmer:

'*Root* branching, many-headed, with fusiform root fibres. *Stems* up to 50 cm. high, simple or slightly branched, more or less pubescent,

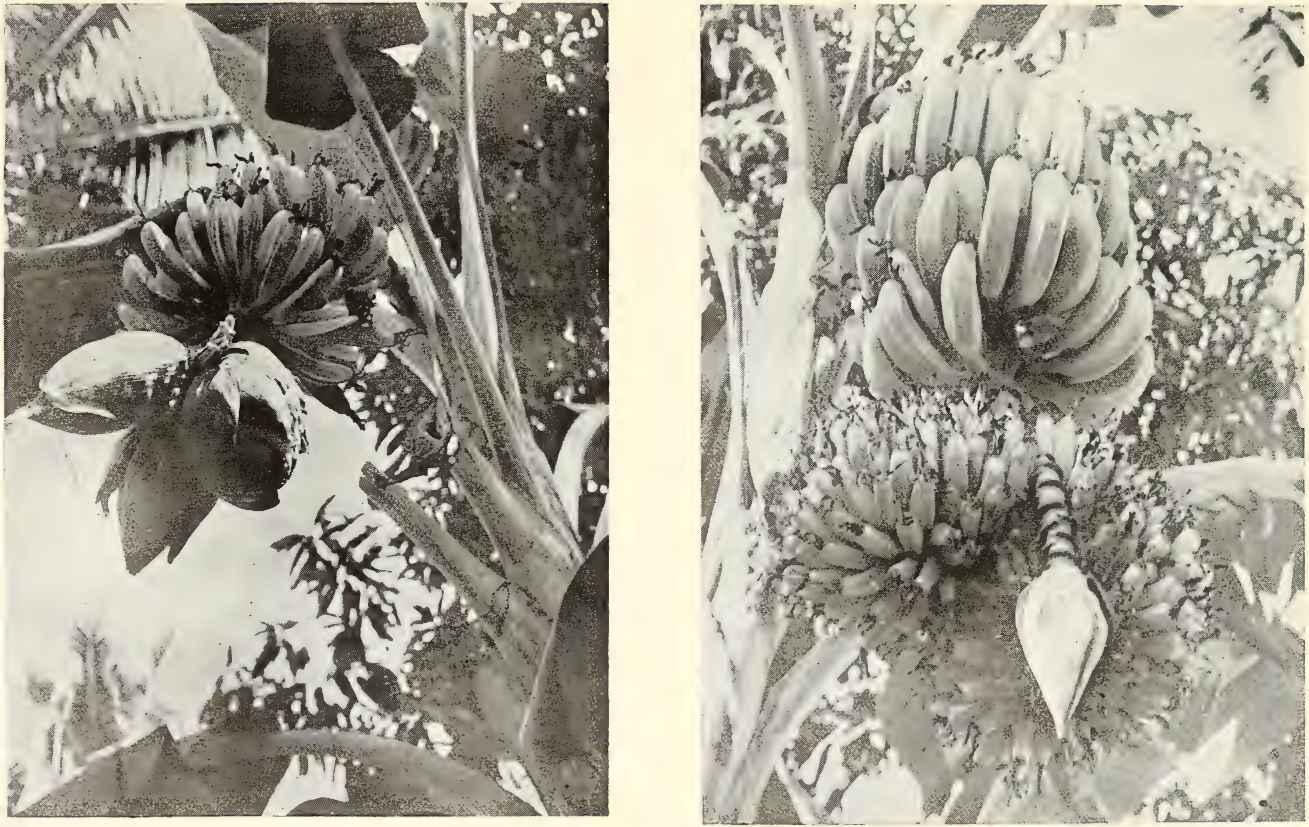
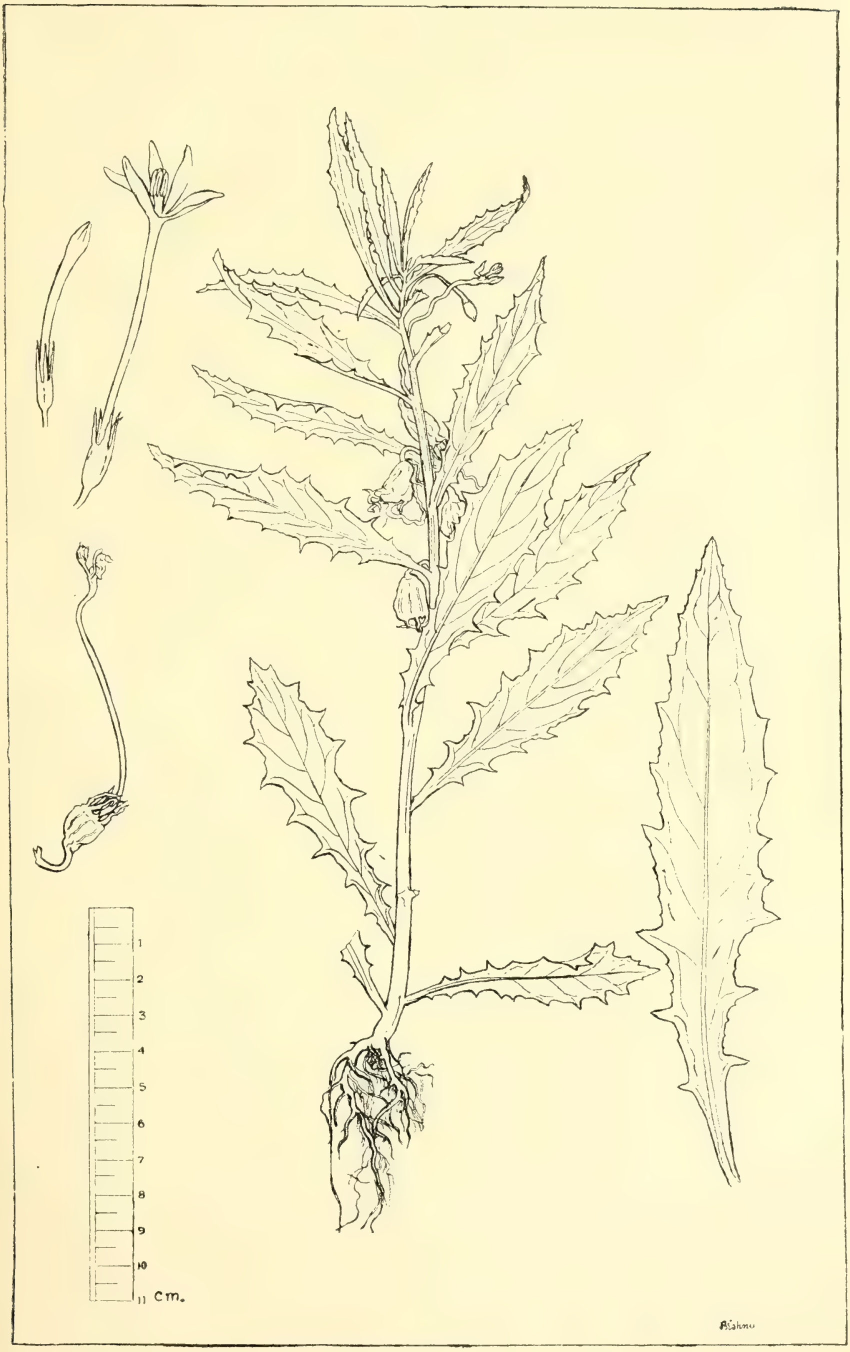


Photo by K. R. Ramasami

Abnormal inflorescence in Banana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Bishnu

*Laurentia longiflora* Endl.

angled with two double lines from the base of the leaves, generally leafy. *Leaves* subsessile, lanceolate, 6-17 cm. long, 1-5 cm. broad, acute, base decurrent into an obscure petiole, the margins remotely and unequally roughly dentate or repand dentate, at times sparsely pubescent, at other times glabrous and pubescent only on the midnerve, somewhat thick, slightly membranous when dry, the midnerve prominent, whitish. Flowers solitary in the axils of the higher leaves. Pedicels 5-8 mm. long, hairy, somewhat thick, with two filiform bracteoles above the base. *Calyx* turbinate, hairy, 5 mm. long; calyx lobes triangular-linear, 10-13 mm. long, remotely callously denticulate, subhairy, erect. *Corolla* white, pubescent, sweet-scented or inodorous, tube narrowly cylindric, 7-9 cm. long, 2-3 mm. broad, straight, the limb sub-bilabiate, patent; lobes lanceolate, about 15-20 mm. long, 4 mm. broad, glabrous on the inner side. *Anthers* pale, glabrous, bearded at the apex. *Capsule* ellipsoid, 10-nerved, sparsely hairy, 15 mm. long, about 10 mm. broad. *Seeds* ovoid, somewhat compressed, scrobiculate, dark, about 0.8 mm. long.'

The plant is said to be a native of the West Indies, Central and South America; it has been seen in Pennsylvania, Hawaii, Malacca, Java and Ceylon; there seems to be no record from India. I have seen the plant from Bombay gardens as an introduced weed; also growing in waste lands at Castle Rock (Santapau 17662); in Blatter Herbarium there are some specimens collected from Victoria Gardens, Bombay.

It may be of interest to add a few remarks on the poisonous qualities of the plant. Wimmer notes on the subject:

> 'A most poisonous plant, containing the base *Isotomine*, which retards heart beats. Jacquin experimented with this plant and noted on the subject: "This plant, taken internally, is a violent purgative, which cannot be counteracted by any remedies until finally it proves lethal. If the juice of this plant falls on the hand, and then one rubs eyes or lips, a burning inflammation is produced." The plant is said to be particularly harmful to horses so that if a horse eats it, the horse will burst through the middle, hence the common Spanish name of "Revienta-Caballos" (The Horse-splitting weed).'

The flowers of this plant are rather attractive, and for this reason the plant is sometimes cultivated in gardens, from which it has escaped and is now naturalised in several tropical countries. At the present stage, when the plant has not yet spread in India we are still in time to try and eradicate such a dangerous weed from our country.

The nomenclature of the plant is as follows:

*Laurentia longiflora* (Linn.) Endl. Gen. Pl. 512, 1838; synonyms: *Lobelia longiflora* Linn. Spec. Pl. 930, 1753; *Isotoma longiflora* Presl., Prodr. Lobel. 42, 1836; *Hippobroma longiflora* G. Don, Gen. Syst. 3: 717, 1834.

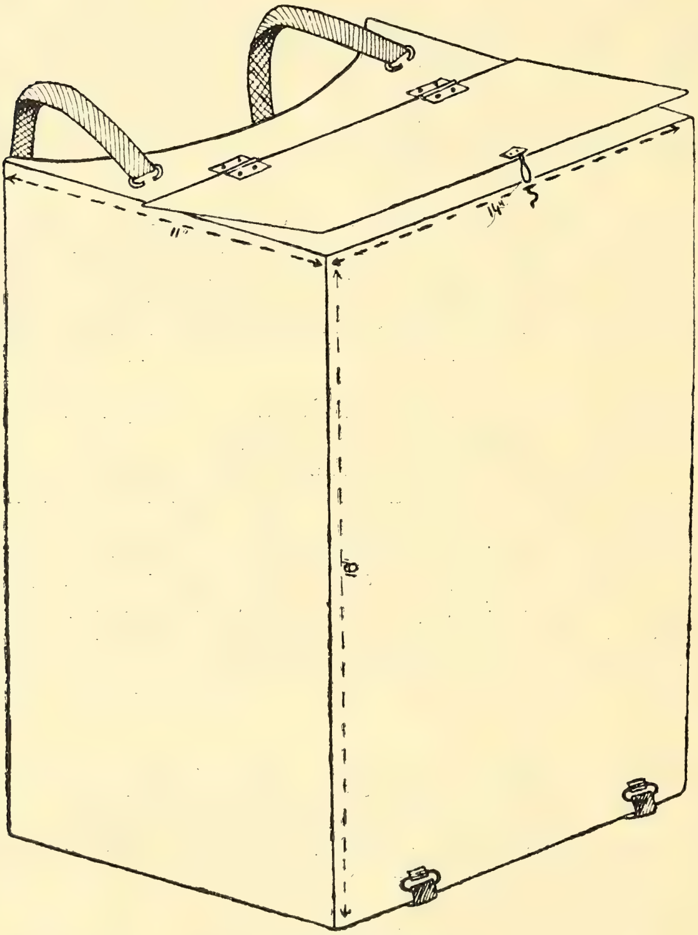
CALCUTTA,
*December* 5, 1954.

H. SANTAPAU, S.J.,
*Chief Botanist,*
*Botanical Survey of India.*

## 32. A VASCULUM FOR THE MOUNTAINEER

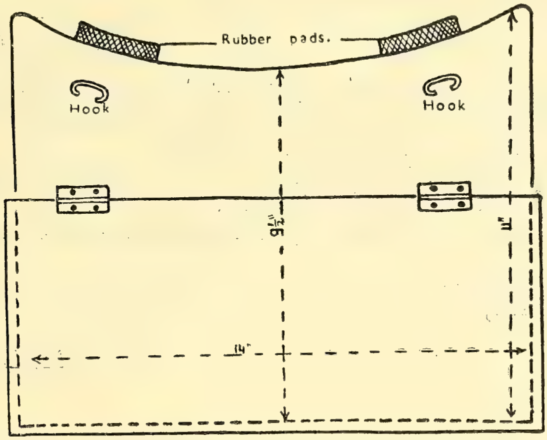
(*With two figures*)

For a field botanist a vasculum or a bag is a necessity. But the conventional vasculum has certain disadvantages. It offers little space when the collection is big, further it becomes rather troublesome to carry it in the hand for long. A bag, too, has its disadvantages.



THE VASCULUM

Usually the specimens in the bag wilt so much that they offer difficulty in pressing if the specimens have been in the bag for long and when the day is hot and sultry. For a botanist working in the Himalayas the days are not so hot as in the plains, but his collections are fairly big to be carried in one of the conventional types of vasculum. His hands must be free. While working in East Nepal I have tried my best to keep a porter with a basket with me. The porter keeps company for a few days and then feeling lonely he joins his fellow porters and is rather reluctant to remain with me. With all possible care I have found the specimens showing signs of wilting. Experiencing such difficulties I have devised a vasculum which is big enough to hold a good-sized collection, and keep the hands free. One would suggest pressing the plants shortly after collecting them. But the conditions under which one has to work in Nepal are best understood by those who have been there. It becomes next to impossible to press the plants before you are back in your camp. It must be said that these observations apply when the party consists of a handful of persons and not to the bigger expeditions.



SECTION FROM ABOVE

The usual biscuit tin of 38 lb. capacity is 18″ high × 14″ × 14″. It is remodelled so that it slings over the shoulders and offers the least difficulty in carrying, being light in weight. The tin canister is cut along one of the sides and resoldered so that the face is curved to fit the curvature of the back. This curved face is padded with foam rubber. Straps from a junk shop are good enough to form the two shoulder straps. The straps are hooked on the top, and passing below the base are attached to the opposite face. This gives support to the canister and, besides, the tin, when slung over the shoulders does not move. A lid is provided, thus big-sized specimens can be easily placed in the vasculum by the carrier himself.

I have used this vasculum during the last two visits to Nepal and having found it very convenient I make bold to suggest that this seems to be the right type for those working in the Himalayas. With such a vasculum I have felt great ease in collecting, placing the specimens in the vasculum and in climbing rocky ledges with the vasculum on the back, both hands being free all the time.

The total expense incurred (at Meerut) is:—

| | |
|---|---|
| Cost of the canister ... ... ... | Rs. 1-8 |
| Straps (from military disposals store) ... | ,, 1-0 |
| Rubber pads ... ... ... ... | ,, 2-0 |
| Tinsmiths charges ... ... ... | ,, 2-0 |
| Total | ,, 6-8 |

Some minor modifications can be made to hold specimen tubes. Small attachments on the sides will be good enough, provided they have lids to prevent the tubes from falling.

As to the durability, I have carried a load of 22 seers (approx. 44 lb.) in this vasculum cum 'haverbox' during my lone trek to Gangotri.

The accompanying diagrams give the details of the construction.

Botany Department,
Meerut College,
Meerut.

M. L. BANERJI

## 33. GLEANINGS

### *An Eastern Invader.*

'An instance (of baneful introduction) is the Chinese Crab (*Eriocheir sinensis*), a crustacean and clandestine passenger to Europe in a long-voyage ship. Noticed for the first time in 1942 it has now infested rivers in Germany, Scandinavia, Holland, Belgium and France. It is very omnivorous and eats up the fishes' nourishment, breaks fishing nets, mutilates the captured fish, burrows in the banks of rivers thereby causing erosion in those borders, and finally has been proved to be a dangerous carrier of a human malady—parasitic hemoptisy. In spite of extensive operations the invader continues to advance.'

—*I.U.P.N. Bulletin*, December 1954.

### *Birds of Prey.*

Defending Birds of Prey, an article in the 'Wisconsin Conservation Bulletin' quotes striking facts and figures on the diet of hawks and owls. 'Stomach contents of 5,000 hawks were examined and the birds supposedly a prime enemy of poultry, showed 55% of their food to be rats and mice.'

Other figures given as to owls confirm an impressive toll on the mice population by the night birds.

—*I.U.P.N. Bulletin*, December 1954,

## *Crabs as enemies of Snakes.*

Writing of Sikkim in 1877 (*Stray Feathers*, v, 382) of the changes taking place in the status of animal and plant species due to the spread of cultivation and other human influences, J. A. Gammie says:—

'Snakes, on the other hand, are getting more abundant year by year, but their greatest enemy, the land crab, is scarcer, which may account for the increase. Crabs do not thrive in the grassy jungles which have taken the place of the forest trees, but snakes do, the latter thus gaining a double chance of multiplying.

It is amusing to watch a crab trying to draw a snake that has partly got into its hole. He catches it by one "hand" quite close to the hole and holds it tight till it yields a little, when he clutches it in front with the other, and so on, till the snake either yields altogether or breaks. Usually the crab has to be satisfied with the tail-end on which he makes a hearty meal, tearing it in pieces and handing the morsels into its out-of-the-way mouth in a very ludicrous manner. Those with an unfortunate—for themselves—prejudice against snakes may think that snake-killing is the particular mission of the crab to the warmer slopes of the Himalayas; but I hope, and believe, that it has a better part to play in the economy of nature than that of destroying our many charming species of harmless snakes.'

## *Field Rats and Seeding Bamboos.*

'A marked instance of how rapidly animals increase in numbers under extra favourable circumstances occurred in Sikkim in 1867-68 when one of the small hill bamboos flowered and seeded simultaneously all over Sikkim, as is its habit to do about once in five and twenty years. The increase in the number of rats, caused by the extra amount of food, was something marvellous. The seeds yielded by the large masses of bamboos were more than sufficient food for them, and as long as they lasted, the increase went on at an alarming pace. When that food-supply ceased they descended in such legions on the maize fields that on every cornstalk, almost, might have been seen several rats. After the remnant of the corn crop had been harvested, the legions of rats diminished as suddenly as they had increased. So rapid, at these times, are both the increase and decrease that the natives have the idea that they come up the river beds from the plains to eat the bamboo seed, and afterwards take their departure by the same route . . .'

—J. A. GAMMIE, *Stray Feathers*, v, 386.

# NOTES AND NEWS

The Loke-Sálim Ali Sikkim Ornithological Survey resumed its work in mid March 1955 and was in the field up to the end of April. It collected a good deal of additional valuable data concerning high elevation birds.

* * * *

R. S. Dharmakumarsinhji, the first stipendiary Wild Life Preservation Officer to be appointed by the Government of Bombay, or by any State in the Indian Union, took charge of his office with headquarters at Poona on 7 April 1955.

* * * *

Mr. Lee Merriam Talbot, ecologist of the International Union for the Protection of Nature, is on a mission to India to explore the possibilities and nature of the technical assistance the Union can provide in our efforts to save the Lion, the Onehorned Rhinoceros and other rare Indian animals from extinction. Mr. Talbot has visited the lion area of the Gir forest in Saurashtra, and plans to visit Kashmir for the Hanglu, and Nepal and Kaziranga for the rhinoceros before proceeding to Indonesia to investigate the position of the two other surviving Asiatic species.

* * * *

The Indian Council of Ecological Research at the Forest Research Institute, P.O. New Forest, Dehra Dun (India), is attempting to build up an Ecological library. An appeal is made to all Ecologists and Ecological Societies of the world for help. The Council trains teachers and post-graduate students from Indian universities in ecological research and offers facilities to research workers for carrying on original work and in consulting ecological publications. Contributions of ecological publications from publishers, ecological societies and ecologists will be gratefully received by the Secretary of the Council, Dr.G. S. Puri, Forest Research Institute, Dehra Dun (India).

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Prater, S. H. (1948); The Book of Indian Animals, Bombay.

Titles of papers should not be underlined.

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# ON SOME INDIAN LAND SNAILS

BY

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*(With 8 text figures)*

When working on some scientific problems in India recently, we[1] had the opportunity to collect some land snails. Although it was during the dry season (March-May 1953) we could gather series of shells and some living snails on the slopes of the Western Himalayas (Chakrata-Deoban, *ca.* 8,000–10,000 ft.), in the Western Ghats, east of Bombay (Bhimashankar, *ca.* 3,500 ft.) and in the hills of S. Mysore (Byrankuppe, *ca.* 3,000 ft.).

Since the publication of the rather exhaustive studies on Indian Mollusca by H. H. Godwin-Austen and G. K. Gude[2], this zoogeographically important group of animals has been rather neglected. But we may hope that the further development of the Indian Universities will offer good opportunities for Indian students to study molluscs too. Because of their very restricted capacity for distribution, these animals are particularly suitable for studying zoogeographical problems. I hope that this small paper will suggest further studies in this highly interesting field.

The determination of the species was only made possible by comparing the material with the large collections of the Senckenberg-Museum in Frankfurt-am-Main and of the Zoological Museum of the Humboldt

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[1] Dr. B. Rensch. Dr. A. Nolte, Dr. K. W. Harde, Dr. R. Altevogt and myself. The expedition was supported by grants from the Deutsche Forschungsgemeinschaft and of the Kultusministerium of the Land Nordrhein-Westfalia.

[2] H. H. Godwin-Austen, Land and Freshwater Mollusca of India, Vols. I and II, 1882 and 1889-1914, Plates.

G. K. Gude, The Fauna of British India including Ceylon and Burma. Mollusca, Vols. I-III, London 1921, 1924.

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University in Berlin. I take this opportunity to express my best thanks to Dr. S. Jaeckel (Berlin) and to Dr. Zilch (Frankfurt), who allowed me to work in their departments and who kindly helped to determine the species (Dr. S. Jaeckel especially some small species).

Before discussing the species collected, it may be useful to say some words about the technique of collecting and preserving snails in tropical countries. I would also refer those interested to the more complete statements of B. Rensch (*Zool. Jahrb.*, Abt. f. Syst., 61, p. 367, 1931).

In tropical countries land snails may be found especially in forests, among and under dead leaves, under stones, and in and under wet, rotten logs; some species also in gardens etc. It is also possible to find shells, particularly of the very small land species, on the shores of rivers and lakes (zone of inundation). But the most promising places are always dead, rotten logs, where the smallest shells will be found under the bark. It is also useful to collect moist dead leaves and the moist earth underneath in small bags and to pick out the shells later on in camp by spreading this material on a sheet of white paper or a plate. It is also possible to put such material in water: then the small shells, but also small living snails, will float on the surface, and they may be picked out easily with a wet hair pencil. In the hot cultivated plains of India only a few species will be found; but in moister hill regions, especially on limestone, land snails are normally very abundant. It is convenient to pack the shells collected in small bags of gauze or muslin between moss, the smallest shells in small glass tubes. It is necessary to keep the label (bearing data about locality, altitude, underground, habitat, date) separately in a special glass tube, because the living snails like to eat the paper labels.

For determination it will be sufficient to have shells only. For detailed studies dissections of the animals will be needed. To preserve this material, the living snails have to be put in water in tins or glass tubes. It is necessary that no air should be accessible to the animals. Then the snails will stretch out the foot in about 10–20 hours and will die in such position, enabling a dissection of the body later on. They have to be preserved in alcohol of 70% (in a higher percentage the body becomes too hard).

As the shells of many Indian species have a very similar structure and colour, a thorough comparison with types in the Museums of Calcutta and London, or with paratypes in other museums, will be necessary. Anatomical dissections and exact comparisons with Godwin-Austen's drawings will prove the identity. Probably many of the now so-called species will, on closer study, be recognized as merely geographical races of other species. Thorough mapping out of the distributions will help to clarify the zoogeographical connections. The relations of the species of the Himalayas (particularly those of the Assam-Sikkim area) should prove of special interest. An inquiry into the relation between the Palaearctic and the Oriental Regions in the Himalayas, and the question of relics of the glacial periods in the foothills of the Himalayas and in the mountains further south, as far as the Lesser Sunda Islands[1] will reveal fascinating zoogeographical problems.

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[1] B. Rensch, Die Geschichte des Sundabogens: Eine tiergeographische Untersuchung, 318 pp., 20 Abb., Berlin 1936.

## DISCUSSION OF THE SNAILS COLLECTED

### I. PROSOBRANCHIA

1. **Cyclophorus (Glossostylus) stenomphalus** Pfr.

*Cyclostoma stenomphalum* Pfr., *Zeitschr. Malak.* III, 1846, p. 44. Assam (Khasi Hills) Orig. measurements : diameter 35 mm., height 24 mm.

Further localities : Bhutan (Stol.), Elephanta Island, Bombay (Coll. Senckenberg, Berl. Museum).

A series of mostly bleached shells from dry slopes covered with sparse bushes near Bhimashankar *ca.* 3,800 ft. (Western Ghats) Bombay State ; height 24·9–29·0 mm.; diameter 30·4–35·1 mm.

2. **Diplommatina costulata** Bens.

*Diplommatina costulatum* Benson, *Ann. Mag. Nat. Hist.* 2, vol. 4. p. 194, 1849, Landour (W. Himalaya). Orig. measurements : height 2 mm., diameter scarcely 1 mm.

Some series (together with small species of *Sitala* and *Kaliella* and *D. folliculus*) collected on the ground among dead leaves and dry moss in the forests of Chakrata (*ca.* 8,000 ft.) and Deoban (*ca.* 10,000 ft.). Distinguished from *D. folliculus* by the size and by the finer and narrower ribs. The last whorl of *D. costulata* is ribbed more coarsely than the penultimate whorl. *D. costulata* is smaller and has a more blunt form than *folliculus.* Measurements : height 2·2–2·3 mm., diameter 1 mm.

3. **Diplommatina folliculus** (Pfr.)

*Buliminus folliculus* Pfr. Symb. Hist. Helic. III, p. 83, 1846 (Landour, Simla, Nainital, W. Himalaya). Orig. measurements : height 3·5 mm., diameter 2 mm.

We collected *D. folliculus* (together with *D. costulata*) in some larger series among moss and dead leaves in the mountain-forests near Chakrata and near Deoban (*ca.* 8,500–10,000 ft.) Measurements : height 3·5–3·7 mm., diameter 1·5-1·9 mm.

4. **Micraulax coeloconus** (Bens.)

*Cyclostoma coeloconus* Benson, *Ann. Mag. Nat. Hist.* 2, vol. 8, p. 189, 1851. South India, Nilgiri Mts. Orig. measurements : height axis 9 mm., diameter 13 mm.

One shell from Byrankuppe (South Mysore) is similar in shape to the compared examples in the Senckenberg Museum. The latter have a reddish brown pattern, which is nearly invisible in my specimen. Compared with the measurements given by Kobelt in his monograph on Cyclophoridae[1] the shell from Byrankuppe has a markedly smaller diameter : height 6·4 mm., diameter 7·3 mm.

5. **Alycaeus strangulatus** (Pfr.)

*Cyclostoma strangulatum* Pfr. *Ztsch. Malak.* III, p. 86, 1846. Orig. measurements : height 2·6 mm., diameter 4·5 mm.

Up to the present this species has only been found in the Western Himalayas [the locality ' Borneo ', which Kobelt published in his monograph of the Cyclophoridae (p. 376) is erroneous, as Gude has already mentioned (p. 269).] We collected a rather large series in the Western

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[1] W. Kobelt, Cyclophoridae in ' Das Tierreich ', 16 Lief., Berlin 1902, (p. 71).

Himalayas (Chakrata and Deoban, *ca.* 8–10,000 ft.) Other known localities in the W. Himalayas are Simla, Nainital, Landour, Mussoorie, Kumaon. Godwin-Austen published figures of this species in the 'Land and Freshwater Moll. India', II, 1914, p. 337, pl. 136, fig. 1, 1a. Measurements : height 2·8–3·1 mm., diameter 4·0–4·2 mm.

### 6. **Cyathopoma deccanense** Blanf.

*Cyathopoma deccanense* Blanford, *Journ. Conchyl.* 16, p. 258, Pl. 12, fig. 2, 1868. (Sylhed—Mountains near Bombay). Orig. measurements : height 3·25 mm., diameter 2·5-3 mm.

Two shells from Bhimashankar, Western Ghats, Bombay State (*ca.* 3,500 ft.) show all the characters mentioned by Kobelt (p. 220) : two or three elevated spiral ribs on the upper side, a peripheral keel, and on the underside two elevated spiral ribs, an umbilicus with several thick ribs. The margin of the aperture is scarcely thickened but elongated on the keel ; aperture a little oblique, circular.

Other localities mentioned by Gude (p. 134) are also situated in the Western Ghats : Khandala, Singhur, Bhore Ghat (Nevill). Measurements : height 3·5 mm., diameter 3·4 mm.

## II. PULMONATA

### 1. **Pyramidula humilis** (Benson).

*Helix humilis* Benson, *J.A.S.B.* VII, p. 217, 1838.

A series collected in the Western Himalayas (Chakrata-Deoban, *ca.* 8,000–10,000 ft.) on chalky rocks and in rifts between them. Compared with the next species, *Pyramidula rupestris sálimalii*, collected on the same place, *P. humilis* shows a flatter shape and a yellow-horny colour (not reddish brown). The whorls on the apex are broader and the aperture is more orbicular, whereas the aperture of *P. r. sálimalii* is more oval. The sutures, especially the last one, are moderately impressed. The umbilicus is wider. The diameter is the same in both species, but *P. humilis* is flatter. The last whorl is bluntly keeled.

Measurements : height 1·1–1·5 mm., diameter 2·6-2·9 mm.

Other localities : Chur near Simla, Landour, Murree (Peshawar), Thandiani.

### 2. **Pyramidula rupestris sálimalii** subsp. nov.

Diagnosis: *Pyramidula r. rupestris* Dr. is distributed over large parts of Western Europe and the Mediterranean region and has been found also in the countries surrounding the Caucasus, in Syria and Western Persia. The new race from the Western Himalayas is higher in relation to the diameter. Ehrmann in 'Die Tierwelt Mitteleuropas' vol. II, 1937, p. 57, states, that *P. rupestris* shows much variability in the relation of height to diameter. But the greatest height is 1·75 mm., whereas the race of the Himalayas has a height of 2 mm. or more. The maximum diameter of *P. r. rupestris* may be 3 mm. The largest diameter of the new race is only 2·9 mm. The shells are nearly conoid. Colour red-brown like in the nominate race. 4½–5 whorls instead of 4–4½ in *P. r. rupestris.* Both races have a very fine, irregular sculpture. The aperture is more circular than in *P. r. rupestris.* The last whorl is descending.

Type: Senckenberg Museum, Frankfurt a.M., No. 153491.

We collected a series in the Western Himalayas (Chakrata–Deoban, *ca.* 8,000-10,000 ft.). Measurements : height 2·0–2·5 mm., diameter 2·5–2·9 mm.

I name the race in honour of our friend Sálim Ali, the well-known Indian ornithologist, who was so helpful during our expedition.

### 3. **Truncatellina cylindrica himalayana** (Benson).

*Pupa himalayana* Benson, *Ann. Mag. Nat. Hist.* ser. 3, XII, p. 428, 1863. Orig. measurements : height 2 mm., diameter 1 mm. Orig. localities : Simla and Mussoorie.

The measurements (height 1·9–2·1 mm., diameter 0·7–0·9 mm.) of the series from Deoban (*ca.* 10,000 ft. W. Himalayas) are the same as those of the shell described by Benson. Gude pointed out that *T. himalayana* is related to *Columella edentula* Dr. But I believe that there exists a much closer relationship with the widespread *T. cylindrica*, only the number of whorls of the two species is different. *T. himalayana* has 6½–7 whorls, *T. cylindrica* has 5–6, the measurements being the same. The sculpture is also alike : *T. himalayana* has 58–62 ribs on the penultimate whorl. Ehrmann (in ' Die Tierwelt Mitteleuropas ', p. 44) mentions *ca.* 65 ribs in *T. cylindrica*. The shape of the aperture is also the same. Up to the present the distribution of *T. cylindrica* is (after Ehrmann) Morocco, Tunis, Portugal, Asia Minor, Crimea, Caucasus to Transcaucasia. *T. himalayana* is also found in Kashmir (Pir Panjal Range). Perhaps there exist also connecting forms in Afghanistan. The relationship of these two species is so convincing that I believe that *T. himalayana* can well be considered a geographical race of *T. cylindrica*.

Type: Senckenberg Museum, Frankfurt a.M., No. 153492.

### 4. **Boysidia plicidens** (Benson).

*Pupa plicidens* Benson, *Ann. Mag. Nat. Hist.* Ser. 2, IV, p. 126, 1849. Orig. measurements : height 2 mm., diameter 1·5 mm.

Six specimens from the Western Himalayas (Chakrata-Deoban, *ca.* 8000-10,000 ft.) among dead leaves and moss. The measurements are the same as those of the type : height 1·9–2·0 mm., diameter 1·4–1·7 mm. The eight folds in the aperture (3 parietal and 5 palatal) are variable. One specimen corresponds exactly with Gude's description (p. 295). *Boysidia plicidens* and *B. landurensis*, which Pilsbury described from the same locality, are very similar. It would be necessary to compare both species to confirm the alleged differences. Up to the present *B. plicidens* and *B. landurensis* are the only Indian species of this genus. *B. salwiniana* Theobald is known from Burma.

### 5. **Ena arcuata** Küster.

*Bulimus arcuatus* (Hutton) Küster, Conch. Cab. *Bulimus*, 1845, p. 56, pl. 17, fig. 1, 2. [Other localities (Gude, p. 239) : Kashmir, Mahasu, Simla and Narkanda—W. Himalayas.]

Five sinistral shells of this relatively large species from Deoban (W. Himalayas, *ca.* 10,000 ft). All shells are more or less bleached. They were collected together with large series of a dextral form which I had identified as *Ena hanleyanus* (Kob.) after comparison with shells in the Senckenberg Museum. But now I believe that this dextral *Ena* may also be *E. arcuata*, for the shape of the sinistral species seen in a mirror is absolutely like the dextral species. However, the type locality of *hanley-*

*anus*—the Nilgiris—is geographically so far away, that this species is probably not quite identical with *arcuata*.

Measurements; height 13·4–15·8 mm., diameter 5·4–6·8 mm.

### 6. **Ena vibex** Küster.

*Bulimus vibex* (Hutton). Conch. Cab. *Bulimus*, 1845, p. 57, pl. 17, fig. 5, 6. West Himalayas: Simla, Landour, Mussoorie.

A large series of this slender sinistral *Ena* from the Western Himalayas near Chakrata and Deoban (*ca.* 8,000-10,000 ft.) shows the characteristic hyaline white lines on the dark horny-yellow shell, already mentioned by Gude (p. 237). The relation of height to diameter is variable. Height of the shells from Deoban: 11·8–15·1 mm., diameter 4·3–5·0 mm. Gude (p. 237) gives similar measurements for 27 specimens from Simla (height 11–12 mm., diameter 4–4·5 mm). The figure published by Gude seems to have too large a diameter in relation to the height.

### 7. **Rachisellus praetermissus** (Blanf.)

*Bulimus praetermissus* Blanford, *J.A.S.B.* xxx, p. 360, 1861.

We found only juvenile animals of this species near Byrankuppe (*ca.* 3,000 ft., southern Mysore) on the bark of small orange trees planted round the forest bungalow. The shells have 6–6½ whorls, a height of 16·8–18·1 mm. and a diameter of 9·7–10·5 mm. As I could not compare my specimens with typical *R. praetermissus*, I only checked them with Blanford's description (Gude, p. 275). On the underside the chestnut brown bands are continuous, whereas the two bands on the upperside of the whorls are interrupted. There is also a very fine spiral sculpture.

### 8. **Rachisellus punctatus** (Anton).

*Bulimus punctatus* Anton, Verz. Conch., p. 42, 1839 (Height 10 mm., diameter 5 mm.)

Four not quite adult specimens of this widely distributed species correspond with Anton's description: a small brown band on the periphery of the last whorl, apex black, shell whitish horn coloured with irregular hyaline brown points.

Measurements: height 14·1–14·2 mm., diameter 6·8–7·1 mm. (not quite adult). Gude (p. 279) gives similar variable measurements.

### 9. **Cylindrophaedusa cylindrica** Pfr.

*Clausilia cylindrica* Pfr., Symb. Hist. Helic. III, p. 93, 1846.

Small series were collected in the Western Himalayas (Chakrata-Deoban, *ca.* 8000–10,000 ft.). One of four specimens from Chakrata and all specimens from Deoban are more strongly costulated. But as all the other characters are alike, I believe that all specimens belong to the same species.

Measurements: height 12·0–16·4 mm., diameter 2·7–3·0 mm. Other localities (Gude): Landour; Mussoorie; Dharmsala, Nainital; Simla; east of Ravi; Thandiani and Mori (Punjab); Tezpur (Assam).

### 10. **Glessula beddomei** (Blanford).

*Achatina beddomei* Blanford, *J.A.S.B.* xxxv, p. 41, 1866 (Height 30 mm., diameter 11·5 mm., Anamullai Hills).

We collected this species near Bhimashankar (Bombay State) at *ca.* 3,500 ft. The partly bleached specimens were found on the dry grass-slopes together with *Cyclophorus stenomphalus* and *Macrochlamys pedina.* Shells of this species in the collection of the Senckenberg Museum are identical. But Blanford mentioned only 7½–8 whorls, whereas the specimens from Bhimashankar have 10–10½ whorls although the measurements are alike: height 30·7–34·0 mm., diameter 11·5 mm. (Blanford gives height 30 mm., diam. 11½ mm.). Our specimens also show an acute apex leaning a little bit to the right side.

### 11. **Glessula pseudoreas** (Nevill).

*Stenogyra (Glessula) pseudoreas* Nevill, *J.A.S.B.* 1, p. 136, 1881.

Two of the 4 specimens collected near Byrankuppe are adult and have 7½–8 whorls. Specimens in the collection of the Senckenberg Museum from the *terra typica,* Nilgiri Hills, are identical: height 11–12·2 mm., diameter 4·1–4·8 mm., The two smaller specimens have 7 whorls, and a height 8·5–8·8 mm. and a diameter of 3·6–3·9 mm. According to Nevill the typical Nilgiri specimens with 6 whorls have a height of 11 mm. and a diameter of 5 mm. Only larger series will show the real variability of this species.

### 12. **Glessula pulla** Blanf.

*Glessula pulla* Blanford, *J.A.S.B.* xxxix, p. 21, pl. 3, 1870.

Three adult specimens from Bhimashankar (Bombay-State) *ca.* 3,500 ft. Terra typica of this species is 'Torna near Poona', not far from the locality where we found this small, brownish, corneous *Glessula.*

Measurements: height 6·4–8 mm., diameter 2·6–3·0 mm. with 7 whorls.

### 13. **Kaliella bullula** (Hutt.)

*Helix bullula* Hutton, *J.A.S.B.* March 1838, p. 218 ('Found among dead leaves at Simla').

Two adult shells among dead leaves near Chakrata and Deoban in the Western Himalayas at *ca.* 8,000 ft. together with other *Kaliella, Sitala* and *Diplommatina* species. They correspond with the figure given by Godwin-Austen (Pl. V, fig. 4). Shell bluntly conoid, pale whitish horny with very fine regular spiral sculpture. 5–5½ whorls a little rounded, the last bluntly rounded at the periphery, a little umbilicated, aperture semilunate. *K. bullula* cannot be confused with *K. fastigiata,* the latter being more stout and roundish.

Measurements: height 2·9–3·2 mm., diameter 3·1–3·3 mm.

*Kaliella nana,* the third *Kaliella* from the same locality, is smaller and narrower wound. The last whorl is not much broader than the penultimate, in contrast to *K. bullula* which has a more inflated last whorl.

### 14. **Kaliella fastigiata** (Hutton).

*Helix fastigiata* Hutton, *J.A.S.B.* vol. VII, pt. 1, p. 217, 1838.

We collected this *Kaliella* together with other species of *Kaliella, Sitala* and *Diplommatina* among dead leaves near Chakrata (Western Himalayas, at *ca.* 8,000 ft.) The shells correspond with the figure given by Godwin-Austen Pl. II, fig. 8 (Mussoorie). My shells have 7½ whorls, being a little flat below. The umbilicus is covered by the margin of the spire. The last whorl is carinated, horny coloured, with regular fine ribbed sculpture. The aperture is nearly quadrangular.

Measurements: height 3·8 mm., diameter 3·7 mm.

Compared with *K. barrackporensis* Pfr., *K. fastigiata* shows a relatively smaller diameter and is therefore conspicuously slenderer. Other locality: Landour.

15. **Kaliella nana** (Hutton).

*Helix nana* Hutton, *J.A.S.B.* vol. vii, p. 218, 1838.

As already mentioned by Benson (cf. Godwin-Austen, Land and Freshwater Moll. of India, Pt. II, p. 21, 1882) *Kaliella nana* was found in great numbers in the same locality as *K. bullula* and *K. fastigiata*. *K. nana* is well distinguished from other species by smaller size and globosely conoid shape. It has 6 roundish whorls, the apex is blunt, the suture is impressed and the last whorl is hardly broader than the last but one. The shell is horny coloured and shows a fine regular sculpture, a narrow umbilicus and a semilunate aperture. Godwin-Austen gives the following measurements: height 2·0 mm., diameter 3·0 mm. The largest specimens which we collected between Chakrata and Deoban (about 8,000 ft.) are relatively broader: height 2·1–2·3 mm., diameter 2·5–2·8 mm. Other localities: Simla, Mussoorie. Godwin-Austen believes that specimens from localities in Bengal are not determined exactly.

16. **Macrochlamys petrosa** Hutton.

*Macrochlamys petrosa* Hutton, *J.A.S.B.* vol. III, p. 83 (1834) (cf. Godwin-Austen p. 78: *J.A.S.B.* pl. III, p. 83, Feb. 1832.)

Two specimens were collected together with *M. prona* Nevill near Deoban (W. Himalayas, *ca.* 10,000 ft.). These two species are conspicuously different. *M. petrosa* has nearly 6 whorls. The embryonic whorls are not wound so narrowly as in *M. prona*. The first three whorls have a width of 5·6 mm. The umbilicus is extremely narrow and resembles *M. prona* in shape and size. Both species show a horny colour, but the sculpture is quite different. The growth lines are crossed by a stronger regular spiral sculpture, partly forming fine spiral ribs. Further on there are fine oblique lines, being rather faint on the last whorl. Thus the sculpture resembles a fine wickerwork.

Measurements: height 14·2 mm., diameter 25·4 mm. (Godwin-Austen: height 10.8 mm., diameter 24·2 mm.)

17. **Macrochlamys prona** Nevill.

*Macrochlamys prona* Nevill, Moll. Yarkand Exp. p. 17, 1878. (*Terra typica*: 'Masuri', NW. Himalaya).

A series of 7 adult and some juvenile specimens was collected near. Deoban (*ca.* 10,000 ft.) and one specimen near Chakrata (*ca.* 8,000 ft.). The specimens from Deoban correspond with the description (p. 103) and figures published by Godwin-Austen. A later comparison with the type would be necessary. In Northern India so many species of *Macrochlamys* are found that a general revision with special regard to the geographical distribution is urgently needed. Our shells may be characterized by the following description: very narrowly umbilicated, 6 narrowly and regularly growing flat whorls (the first 3 together have a width of 4 mm.), shell horny brown, a little lighter on the underside. The growth lines are crossed by very fine spiral lines. The figure of the sculpture given by Godwin-Austen corresponds with our shells from Deoban.

Measurements: height 10·4–11·0 mm., diameter 20·5–21·7 mm. (Godwin-Austen: height 7·0 mm., diameter 18·2 mm.).

### 18. **Macrochlamys pedina** (Benson).

*Helix pedina* Benson, *A. M. Nat. Hist.* Ser. 3, vol. xv, p. 13, 1865. (Bombay and Ahmednagger. Height 14 mm., diameter 32 mm.).

A large series from dry grass-slopes near Bhimashankar (*ca.* 3,500 ft., W. Ghats) two specimens from Deoban (*ca.* 10,000 ft., W. Himalayas). Two living specimens from Bhimashankar copulated and laid eggs in a terrarium in Münster. Unfortunately the eggs did not develop. Two copulations took place, one on the 3rd of August 1953 from 9 till 9·50 a.m. and the other on the 3rd of September at about 6 p.m. At first each animal touched the tail of the other or crept over the end of the tail. Under the little horn of the tail was a little lump of secretion. Then the animals pressed their genital apertures together. At the same time the stimulus organ was stretched out (about 2 cm.) touching and seeking around. Alternately it was slack or puffed up. This act lasted about 45 minutes. During this time both penes were introduced for a couple of minutes. Then one penis was drawn back, a few seconds later the other one. Both stimulus organs were still swollen but hanging down. One minute later these organs were drawn back, too (cf. fig. 1).

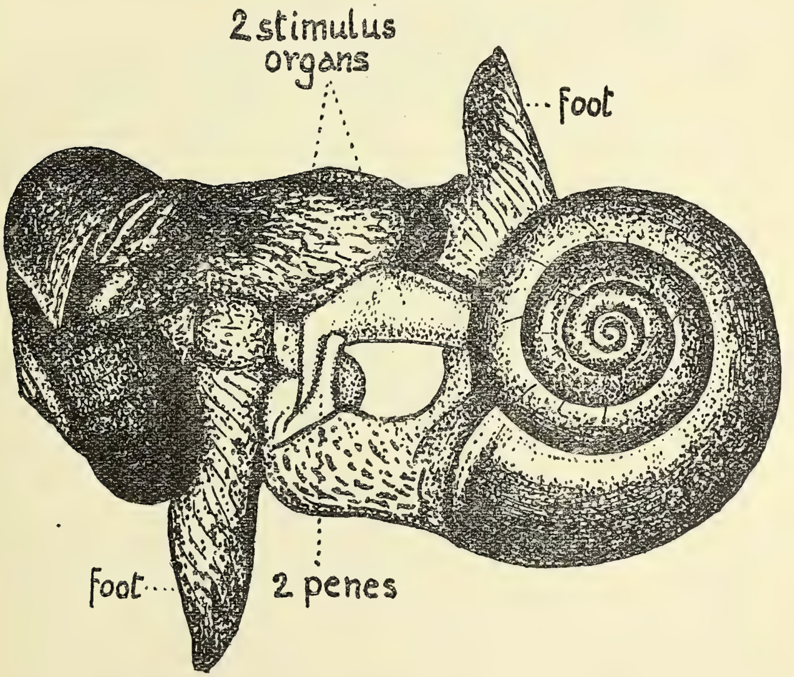

FIG. 1. Copulation of *Macrochlamys pedina* (Benson) Both animals connected by the two penes. Below them, to the right, the much thicker stimulus organs.

Godwin-Austen already published a figure of the genital organs (pl. LXXXIII). It resembles my own figure of the organs of the animals, which had copulated in Münster (fig. 2).

The radula (fig. 3) had 115-120 rows of teeth. After the pointed middle-tooth follow 16-18 teeth with a large point, then 36-38 teeth with one larger and one smaller point.

Measurements : height 17·3–22·8 mm., diameter 28·4–34·7 mm.

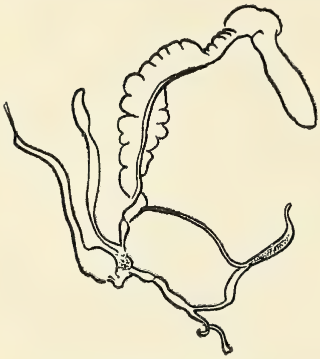

Fig. 2. Genital organs of *Macrochlamys pedina* (Benson).

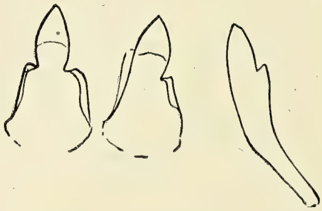

Fig. 3. Radula-teeth of *Macrochlamys pedina* (Benson).

### 19. **Macrochlamys splendens** (Hutton).

*Nanina splendens* Hutton, *J.A.S.B.* vol. VII, pt. 1, p. 215, 1838.

A series from Chakrata and Deoban (8,000–10,000 ft.) W. Himalayas. The greenish horny coloured shell has 7½ closely wound flat whorls, the last of which is rounded. The shell is narrowly umbilicated, the aperture semilunate. Godwin-Austen's figure (pl. XXII, fig. 4, 4a), shows well the typical convexity of the shell and the brownish yellow line behind the aperture, which our shells also have.

Measurements : height 7·4–10 mm., diameter 13·1–18·2 mm. (diameter of the type 16·4 mm.).

All localities of *M. splendens* are situated in the Western Himalayas : Nag Tibba ridgenear Mussoorie ; forest of Mahasu, Fagu and Nagkunda (10,000 ft.), and Hattu (11,500 ft.) (places in the surroundings of Simla) and Chakrata-Deoban.

We could also preserve some living animals in alcohol. The radula has 76–80 rows (fig. 4). The middle tooth has a main point and two

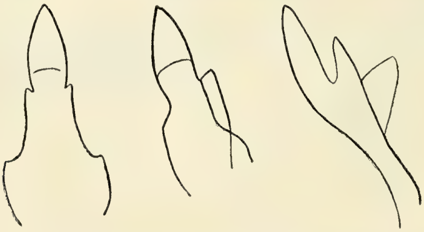

Fig. 4. Radula-teeth of *Macrochlamys splendens* (Hutton).

smaller points on both sides. The 12 following teeth have a smaller point on the outer side, and the 26–28 marginal teeth are two-pointed. (Godwin-Austen's numbers : 32-12-1-12-32).

The genital organs are typical (fig. 5). The receptaculum is long

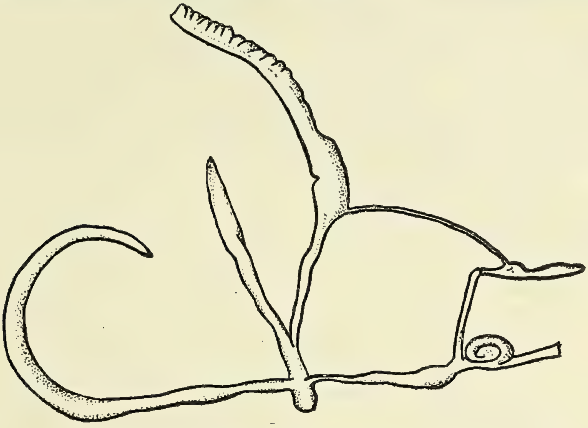

Fig. 5. Genital organs of *Macrochlamys splendens* (Hutton).

pointed and without a clearly separated bursa, the long amatorial organ has the shape of a sausage and is pointed at the end. The hind part of the penis bears a spiral container for the retractor muscle. In other *Macrochlamys* species a similar flagellum-like appendix at the end of the vas deferens is considered by Godwin-Austen to be a lime sack.

20. **Euplecta indica** (Pfr.)

*Helix indica* Pfeiffer, Symb. III, p. 66, 1846. (Syn. *Helix shipleyi* Pfr., *P.Z.S.* p. 327, 1856).

We collected a large series of this nice species, characterized by their special sculpture, near Byrankuppe (*ca.* 3,000, feet, Southern Mysore). Specimens with 6 whorls measure: height 13·3–16.3 mm., diameter 21·4–24·5 mm. (Pfeiffer : height, 12 mm., diameter 22 mm. The number of the spiral ribs, crossing the fine growth lines is 16–20.

Distribution : Nilgiri, Anaimalai and Palni Hills, Wynaad and Western Mysore as far north as the Kadur district, the lower country of Malabar, Travancore, Ceylon, Mahlos, Maledive.

21. **Ariophanta laevipes** (Müll.)

*Helix laevipes* Müll., Hist. Verm. II, p. 22, no. 222.

We collected 3 adult shells near Bombay (Bandra and Kanheri Caves). One shell is chestnut-brown, the second one is greyish white, the 3rd specimen has brown bands.

Measurements: height 14·2–15. mm., diameter 23·6–26·7 mm.

22. **Ariophanta bajadera** (Pfr.)

*Helix bajadera* Pfeiffer, *Ztschr. f. Malak.* p. 69, 1850. (Bengalia).

We collected a large series on the dry grass slopes near Bhimashankar (3,500 ft., Bombay State) together with *Cyclophorus stenomphalus*, *Mac-*

*rochlamys pedina* and *Glessula beddomei.* Blanford described (Contr. Ind. Mal. no. VII, *J.A.S.B.* p. 32, 1866) a similar species, *A. intumescens,* from the Western Ghats (Mahableshwar). The measurements are the same as those of *A. bajadera.* Blanford wrote: 'I long doubted the distinctness of the species now described as *N. bajadera,* but although I have specimens of the latter from many different places, they are all easily distinguished from *N. intumescens.*' Unfortunately I had no opportunity of comparing with *A. intumescens,* but I believe that our specimens belong to *A. bajadera* because the sculpture is rather strong and the last whorl not blunted, especially not near the aperture as in *A. intumescens.*

Measurements. height 20·5–25·5mm., diameter 22·5–29·0 mm.

### 23. **Sitala infula** (Benson).

*Helix infula* Benson, *A.M.N.H.*, p. 160, 1848 (*Terra typica*: Murshidabad, (Bengal) Patharghata (Behar).

Two specimens from Byrankuppe (3,000 ft. Southern Mysore). Benson described this species from the erstwhile Province of Bengal, Behar and Orissa, and Godwin-Austen (Land and Freshwater Molluscs of India, Pt. 1, p. 26) added Poona and Balarampur in Southern India. The adult shell has 6½ whorls ; height 6·9 mm., diameter 7·0 mm. It is light horny coloured. The spiral lines are faint. The third whorl before the aperture shows 6 elevated spiral lines, whereas a juvenile specimen has rather faint spiral ribs. The adult specimen does not show very much periostracum, but may have had 7 spiral lines too.

### 24. **Helicarion stoliczcanus** Nev.

*Helicarion stoliczcanus* Nevill, Yark. Miss. Moll. p. 15, fig. 19–21. (Syn. *Euaustenia cassida* Hutton, *J.A.S.B.* VII, p. 214, 1838).

Godwin-Austen places *stoliczcanus* Nev. in the genus *Euaustenia*

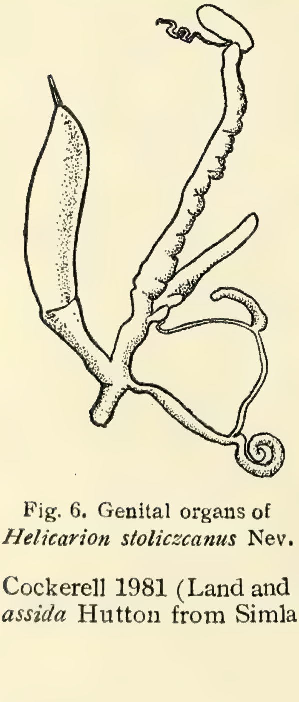

Fig. 6. Genital organs of *Helicarion stoliczcanus* Nev.

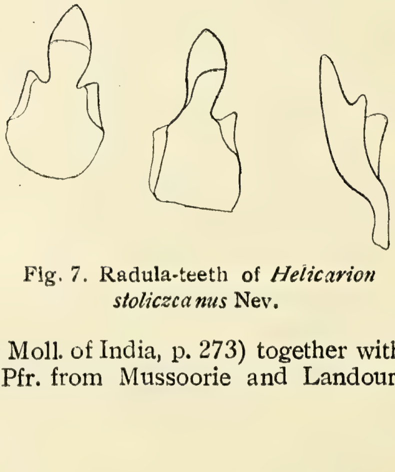

Fig. 7. Radula-teeth of *Helicarion stoliczcanus* Nev.

Cockerell 1981 (Land and Freshwater Moll. of India, p. 273) together with *assida* Hutton from Simla, *monticola* Pfr. from Mussoorie and Landour, *theobaldi* Godwin-Austen from Chenab Valley, Kashmir, and *scutella* Benson from Chamba and Murree (Kashmir). Godwin-Austen believes that these species, being distributed over an area of 750 km. ' prove to be closely allied'. The figures of *monticola* (Mussoorie) and *stoliczcanus* (Almoral) (published by Godwin-Austen Pl. 52, figs. 2 and 3) show a very similar shape to my rather variable specimens from Chakrata and Deoban (8,000–10,000 ft., W. Himalayas). I suspect that Godwin-Austen's *H. cassida* from Kashmir and from Simla belong to the same species. But on the other hand it does not seem impossible that all the species mentioned are geographical representatives of the same ' Rassenkreis '. In any case a revision of all these so-called species would be important. Measurements : height 12·4–14·0 mm., diameter 20·8–25·1 mm.

The genital-organs are similar to those of *Macrochlamys splendens*. (Fig. 6). The radula (fig. 7) has 110-114 rows. On the middle tooth follow 16 with one main point and an outer small point, and then 41 bifurcated teeth.

### 25. **Landouria huttoni** (Pfr.)

*Helix huttoni* Pfeiffer, Sym. Hist. Helic. II, p. 82, 1842.

We collected a small series between Chakrata and Deoban, West-Himalayas, 8–10,000 ft. All shells have only 5 whorls, height 4·6–6 mm., diameter 7·4–9·1 mm. (Pfeiffer mentioned : height 5·5 mm., diameter 10 mm., but 6 whorls). It may be that our specimens are not quite adult. The sculpture on the upper and underside is very striking. The ribs are not continuous, but interrupted in such a way that the surface is covered with irregular long wrinkles and with short small knots.

Distribution : Himalayas (Simla, Landour, Darjeeling) and Kashmir. A revision of species from other localities such as Burma, China, Ceylon is desirable, as perhaps there exist different geographical races.

### 26. **Bradybaena similaris** (Fér.)

*Helix* (*Helicella*) *similaris* Fér., Table Syst. Limacons, 1822, nom. 262, nom. nud. *Helix* (*Helicigona*) *similaris* Fér., Hist. Nat. Moll. liv. XV, 1822, pl. 25 B, fig. 1 (var. α), fig. 4 (var. β), liv. XXIII, 1832, pl. 27 A, figs. 1-3.

I collected one adult and one juvenile shell of this widely distributed species near Mysore. Deshayes (Gude, p. 201) mentioned : height 12 mm., diameter 16 mm. My adult specimen from Mysore is smaller : height 8·8 mm., diameter 14·5 mm. The sculpture is not only ' minute striata ' (original description) but shows fine squamiform points, which are best preserved in the umbilicus.

## APPENDIX

### 27. **' Xestina ' vitellina** (Pfr.)

*Helix vitellina* Pfr., *P.Z.S.* 1848.

Unfortunately the literature about ' *Xestina* ' *vitellina* (Pfr.) was inaccessible (= *Ariophanta belangeri* Desh ?). We collected a series, also in alcohol, near Byrankuppe (3,000 ft. S. Mysore). In the collection of the Senckenberg Museum are specimens from Madras, Malabar and Travancore. The globose shell has a brownish upperside and a lighter underside, becoming whitish near the aperture. The coarse growth-lines on the upperside are crossed by 10–12 spiral-lines. The umbilicus is half covered. Measurements: height 15·4–21·5 mm., diameter 20·6–27·2 mm.

It is very remarkable that the genital organs (fig. 8) show two kinds of amatorial organs. One is similar to the amatorial organ of *Macrochlamys* species. Stretched out, but reduced in size by preservation in alcohol, it measures 20 mm. The other organ is more tubiform, covered with many warts and has a length of 16 mm. in alcohol. In the interior there are strong longitudinal muscles. Besides there is a receptaculum seminis and apparently a thick gland at the beginning of the epiphallus.

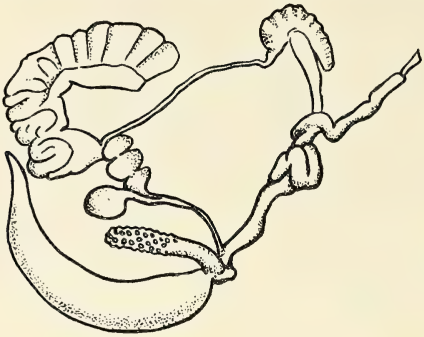

Fig. 8. Genital organs of '*Xestina*' *vitellina* (Pfr.).

# FIELD OBSERVATIONS ON THE DAILY ROUTINE AND SOCIAL BEHAVIOUR OF COMMON INDIAN MONKEYS, WITH SPECIAL REFERENCE TO THE BONNET MONKEY (*MACACA RADIATA* GEOFFROY)

BY

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(*With a plate*)

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## 1. INTRODUCTION

In spite of the excellent opportunity for field observation of Indian monkeys, especially near temples and villages, very little is known and published of their habits and social behaviour. Contrarywise, there are exact observations on monkeys of other countries in the wild state, e.g., on howling monkeys (C. R. Carpenter 1934, N. Collias and Ch. Southwick 1952), on red spider monkeys (C. R. Carpenter 1935), on gibbons (C. R. Carpenter 1940), and on baboons (S. Zuckermann 1932). We therefore took the opportunity during our trip through India under the leadership of Prof. B. Rensch in spring 1953[1] to collect some more information about Indian monkeys. We had particularly good facilities for observation at Byrankuppe, about 45 miles south of Mysore City, where two troops of *Macaca radiata* lived close to our forest bungalow.

For kind help during our stay in India I wish to express my gratitude to Mr. Sálim Ali (Bombay) and to the Forest Departments of Mysore and other States of the Indian Union for permitting us to use the forest bungalows. Special thanks are due to Prof. B. Rensch, who gave me his field notes about Indian monkeys, and to the other members of our scientific party, Mrs. I. Rensch, Dr. K. W. Harde and Dr. R. Altevogt, for their co-operation.

## 2. **The Bonnet Monkey,** *Macaca radiata* Geoffroy

The Bonnet monkey is the geographical representative of the Rhesus, which lives northward of its area. So far as I know, there are no published field observations concerning this species. I studied two troops near Byrankuppe, Mysore (A. Nolte 1955). Observation was facilitated by the light terrain, a forest with little undergrowth in which bamboo clumps dominated. During our stay in Byrankuppe (in April 1953) I usually tried to find the monkeys at their sleeping places early in the morning, before dawn, and followed them for several hours till 10 or 11 o'clock; once till 14·00 o'clock. In the afternoon I looked for them again in their usual feeding places (fruit trees), and accompanied them to their sleeping trees.

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[1] Aided by grants from the Deutsche Forschungsgemeinschaft and the Kultusministerium of the land Nordrhein-Westfalen.

Troop No. 1 consisted of 32 individuals and 2 babies, while there were 33 individuals and 5 babies in troop No. 2. There was a proportion of 1·6–1·7 adult females to one mature male. I got these data by noticing the sex and the probable age of the monkeys when they crossed a path or jumped from tree to tree (average of 6 observations). The adult males were easy to distinguish by their stouter build and larger size. A full-grown male weighs 13–19 lb., a female 7–8 lb. only (S. H. Prater 1948). But I had some difficulty in distinguishing the females from the younger males especially if they moved fast. The composition of the two troops was nearly as follows:

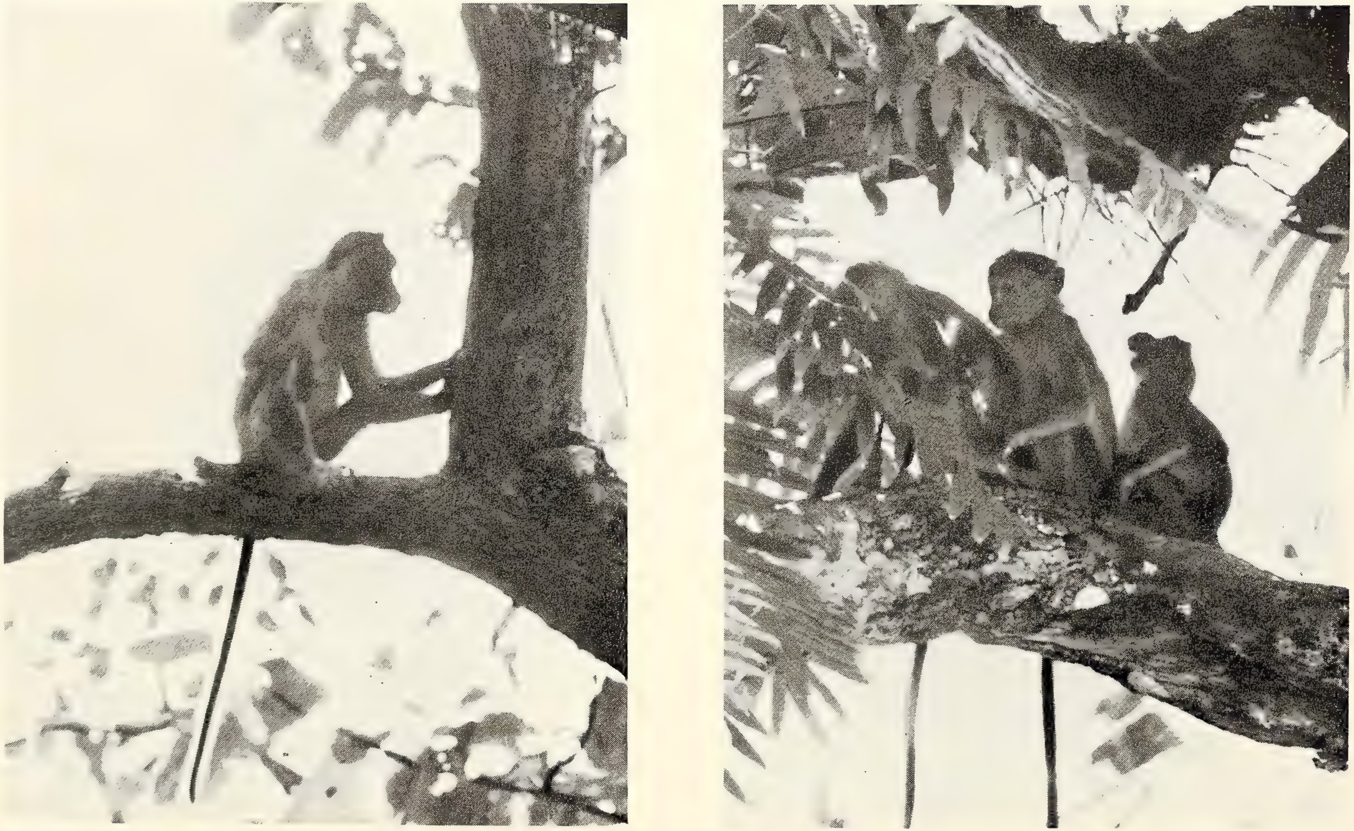
| Troop | ♂♂ | ♀♀ | ♀+ | J | I | Total |
|---|---|---|---|---|---|---|
| 1 | 3 | 5 | (2) | 17 | 7 | 32 |
| 2 | 5 | 8 | (5) | 12 | 8 | 33 |

(♀+ = females with babies; J = juveniles; I = infants).

Among the first three categories, leading the troop when on the move there were relatively more males. A similar fact was noticed by C. R. Carpenter (1934) in howling monkeys, but some years later N. Collias and Ch. Southwick (1952) found twice as many females in front of the same troops as males. It would be of interest to observe one troop over a prolonged period, perhaps with marked individuals, to see if and how often leadership may shift.

The daily movement took place within an area of about 1 square mile. But there was no evidence of defending this 'territory' against other troops. On several occasions, at different hours of the day, both troops were seen feeding on the same tree—and once troop No. 2 was observed spending the night right in the middle of the 'territory' of troop No. 1 and only about 125 yards apart from the sleeping tree of No. 1. Unfortunately, I never observed the moment when both troops met each other.

The monkeys used to sleep in the bamboo thicket at the edge of the Kabbani River, every night at different spots within a distance of 900-1200 yards (they spent only one night 250 yards away from the river in the forest). Average sleeping time during the night was about 11½ hours. The monkeys woke up early in the morning, about 6 o'clock, as soon as the luxmeter deflected a little. They began the daily routine with mutual grooming, defecation and urination. It was remarkable that during the first quarter of an hour they behaved very noiselessly. I never saw them feeding at their sleeping place. About 15 minutes after rising they suddenly went off to one of the fruit trees nearby, not always using the most direct way. Here they fed for 1—1½ hours, at last filling up their cheek pouches. The bonnet monkeys in Byrankuppe ate fruit (mangoes, wild figs, lantana berries), young shoots (especially of bamboo), buds, seeds and insects. After their early morning feed, the monkeys moved forward,



Photos A. Nolte

Macacs during the noonday siesta

mostly on the ground (also in dense teak thicket). Their speed was normally very slow. From time to time they used to rest in the shade, busy with mutual grooming, nursing babies, eating the contents of their cheek pouches, and looking for insects and seeds by turning over old dry bark or leaves. The young were mostly playing during this time. One day I spent a longer time with the troop No. 1 (till 14·00 o'clock). At about the half time between rising and going to sleep (11·30 till 12·50) there was a short siesta (not during the hottest daytime!). The monkeys were sitting on different trees in the shade, some in crotches, others lying on thicker branches. All members of the troop kept silent and quiet, even the young. Some of them shut their eyes and seemed to sleep. A similar nap was described by C. R. Carpenter for the howling monkeys (1934) between 11·00 and 14·00 o'clock, for gibbons (1940) between 11·30 and 15·00 o'clock.

Arriving at the sleeping place about 18·00 o'clock, the monkeys usually first went to the river to drink. They drank with the mouth from the water surface without using their hands. I never saw them drinking after rising in the morning, but sometimes during the day out of a small pool, or they put their hands into the water gathered in hollow stems of bamboo after a shower of rain and licked the droplets from their arms and fingers. In the evening, before the beginning of darkness, the monkeys sat near the sleeping place, ate shoots of bamboo or leaves, here and there and groomed each other. As soon as the night began they disappeared into the bamboo thicket and remained there quietly.

Mutual grooming occupied a considerable part of the day. Here no influence of dominance relations could be observed, as A. H. Maslow (1936) found among rhesus monkeys in the laboratory. Maslow put two monkeys, which had been separated some time before, together in a cage to find out which was the dominant animal, and whether the dominant individual would groom the subordinate one, or vice versa. No self-grooming was observed among bonnet monkeys in the wild state, but I have seen it among two individuals caged together in the Münster zoo.

In neither troop could I observe any real mating behaviour. This would agree with C. G. Hartman's finding (1931) that bonnet monkeys in zoological gardens did not conceive from March till July. Only one part of the mating behaviour, the mounting, could be seen by me several times, but this took place not only between the different sexes, but also between two males, two females or two juveniles. The active partner pulled the tail of the other monkey who looked back over its shoulder, but remained passive during the mounting that followed, which never lasted more than half a minute. Thereafter the two monkeys went their ways without taking any more notice of each other. Mounting without sexual significance has been described by C. R. Carpenter in the rhesus colony near Puerto Rico (1942), by A.H. Maslow (1936, dominance experiments), and by S. Zuckerman in *Hamadryas* (1932). The male position in mounting seems to be a part of the behaviour of a dominant animal.

During the first days of observation the babies of troop No. 1 were already able to move about independently among the branches. But at first the distance from their mothers remained about ½ a yard only. At this time the mothers were extremely attentive towards their babies. If there was any kind of alarm they rushed towards the babies and grasped them quickly. Some days later, they seemed to be less attentive and careful. They climbed away from their babies without looking after them but came back at any tumult. The babies seemed to be more dependent on their mothers in that state. When left alone they cried violently and tried to follow their mothers. Concerning bonnet monkeys there is no information about the length of the dependence-phase of the babies on their mothers in the wild, so far as I know. I saw last year's juveniles leaning towards females and females grasping such young ones and trying to carry them without any alarm situation. But these juveniles were too heavy and they struggled to get away. It seems therefore that even after becoming independent some relationship between mother and baby persists for about one year.

The play of the juveniles occupied a great part of the day. Normally they used to play in flocks of four and more individuals. There was a sort of chase from tree to tree or on the ground, mostly ending with play-fighting. When highly excited, they sprang up into the air with all four legs, or they shook branches violently. Three times I saw such play-fighting end in a subordinate position of one partner: he pressed himself flat on a branch and crawled slowly backward to withdraw himself.

The routine behaviour of the bonnet monkeys was not disturbed by the roaming in their territory of domestic animals (fowls, goats, cows, sheep) tame elephants, and birds of different sizes. But dogs caused a panic flight to nearby trees or termite mounds. The monkeys never ran along the ground, when a dog had caused the flight. From their high position they chattered at the dog, bared their teeth and shook branches. Some time after the dog was out of sight they climbed down very cautiously. A jackal (*Canis aureus*), however, was put to flight by the joint attack of the whole troop on the ground. This social instinct of joint attack or joint flight is very strong. Once I saw the whole troop rushing off together (I could not discover the cause) while a helpless baby cried on a bamboo for its mother, whose mother-instincts were apparently not as strong as her social ones.

### 3. **The Rhesus Monkey**, *Macaca mulatta* (Zimmerman).

The rhesus is found throughout northern India as far as the Tapti River in the west and the Godavari in the east. We know very little about the exact number of individuals in the troops. There are smaller and larger groups. We are much better informed in regard to an artificial rhesus colony on a small island off the coast of Puerto Rico (C. R. Carpenter 1942). In 1938 about 400 rhesus monkeys from India were released there. Fifteen months later Carpenter found most of them organized in 6 heterosexual groups, ranging from 13 to 147 individuals (an average of about 70 animals per group). These data are not comparable with those in India because individuals of many troops were put together in a different environment. In addition Carpenter saw 12 sub-adult males living in unisexual groupings. Among the adults the proportion was six females to one male. A preponderance of females over males seems to be the rule in old and new world monkey troops (H. W. Nissen 1951, S. Zuckerman 1932).

In India we did not have an opportunity to observe rhesus troops for a sufficiently long time, but we never saw such large groups as Carpenter did in the artificial colony. At Kansrao (Siwalik Hills) there was one troop of about 17 individuals and another of 19. As there was no village nearby, the animals were rather shy, and when disturbed they disappeared into the dense underwood. So I could not determine the sex ratio.

There was no newborn baby with them (beginning of March), but some of the females were surely pregnant.

Whether there is a definite breeding season in rhesus monkeys or not, is not yet ascertained. Most observers believe that this is the case, but they do not agree with regard to the month, in which the babies are born. R. W. G. Hingston (1920) and W. Heape (1897, at Muttra) mentioned March as the main month of birth. In the rhesus colony of the Baltimore Zoological Garden most of the babies were born in March and April, but a few in the other months too (C. G. Hartman, 1931). In the colony near Puerto Rico, C. R. Carpenter found most newborns from June till August. In Simla W. Heape (1897) saw babies from August till September. On the basis of his own observations and of the information from the Calcutta Zoo, where the rhesus reproduced at any time of the year, he drew the conclusion that this species breeds at different times in different parts of India. We need more exact data about the breeding season all over India for deciding whether Heape is right, or perhaps S. H. Prater (1948) who mentions that the rhesus breeds at any time of the year.

About the behaviour of the babies and the maternal care there are many observations from laboratories and zoological gardens which need confirmation from the wild state (K. S. Lashley and J. B. Watson 1913, O. L. Tinklepaugh and C. G. Hartman 1932, J. B. Foley 1935, O. L. Tinklepaugh 1942 etc.). The gestation lasts about 6 months. One or two days after birth, the babies are already able to climb upward when frightened. The incisors are well out during the 15th week and then the molars begin to appear. The babies begin to unloose from their mothers after 9 weeks, but thereafter the mothers still take care of the young ones and carry them about at any tumult, sometimes for more than one year, even after the birth of a new baby (O. L. Tinklepaugh 1942).

The sexual behaviour has been studied by C. R. Carpenter (1942) in the colony near Puerto Rico. There is no harem system as among baboons. During the oestrous period (average of 9·2 days) the females are very aggressive to other females. Normally they turn over to the males. In this colony Carpenter found 2 pure male groups (one with 7 ♂♂, the other with 12 ♂♂). With the beginning of maturation the young males separate from the parent group and live in male troops until they reach the adult stage. Then they try to get into a heterosexual group where they normally have to begin with a low dominant rank.

### 4. **The Common Langur**, *Semnopithecus entellus* (Dufresne).

The langur or Hanuman monkey, one of the sacred animals of the Hindus, is often found near temples and villages or in the jungle. In spite of this fact there is scanty, partly contradictory information about the size of the troops, their composition as to males, females and young ones, and their social hierarchy. Langurs have been observed in troops of various composition. The largest assemblages were promiscuous ones. In the literature I do not find any exact numbers given. At Sikandra near Akbar's Tomb, we saw about 50 or more specimens; in the Western Himalayas near Chakrata a troop with about 50 individuals was seen. There was another troop near Kansrao (Siwalik Hills) consisting of 17 monkeys. In these large troops there are males and females of all ages together with young ones (see W. T. Blanford 1888–1891, T. Hutton 1867; S. H. Prater 1948). There is no conformity in the proportion of males to females in such troops. Some observers saw one or two adult males only (T. C. Jerdon 1867, T. H. Hughes 1884). At Sikandra, one of the tomb *chaukidars* (guards) told us that there was one single very bold male (overlord) besides many younger males, females and young ones. It is a pity that we could not stay longer than an hour in Sikandra to get more exact information about this troop, which was half tame, being fed by the guards and visitors.

Besides these large promiscuous troops there are many reports of small groups of males (E. Blyth 1843; T. C. Jerdon 1867, S. H. Prater 1948), of lone males (W. T. Blanford 1888–1891), and of small family parties (W. T. Blanford, A. C. McMaster 1870). The animals in male groups are supposed to have been driven out of the harem on attaining maturity. T. H. Hughes (1884) reported a battle between a male troop and a promiscuous one. Three males chased the single overlord of the mixed group, while the other males tried to separate some females from the harem. It may be that new troops are founded in such a way. One of the disadvantages of extreme social grouping is the strong inbreeding. This would be avoided by separating males from the harem so that they can go over to other troops later, or can establish a family with a female taken from a heterosexual troop.

We saw small groups of langurs near Bhimashankar (W. Ghats) and Byrankuppe (Mysore). Most of them contained 4-5 individuals only. But we were not able to determine if they were family or male groups.

We also know very little about the size of the 'territory' and about the daily routine of langurs. Apparently there exist distinct territories. We saw the same troops for several days in the same part of the forest, especially near Kansrao in the Siwalik Hills. And S. H. Prater (1948) noted that langurs return to the same roosting place every night. But there is no information as to how far they wander during the day and if they use the same feeding grounds day after day. Another question has still to be answered: Do the male groups have special territories, or do they move through the territories of the mixed troops? The same problem has to be solved for the small family troops.

During the hottest time of the day, the langurs were seen resting in the shade often near water courses (C. McCann, 1928; S. H. Prater 1948). When alarmed while running, they raise themselves to their full height to look around, and when sitting on the tops of the trees they will cleverly conceal themselves by grasping and drawing branches together, thus becoming completely hidden (C. McCann, 1928). If they are chased by dogs, they sometimes seem to lose their heads, and, although an aerial crossing from tree to tree may appear quite simple, they will often descend to the ground, where they run with great bounds (F. W. Champion 1928; S. H. Prater 1948). At Sikandra we observed the flight caused by a dog. The langurs were sitting on the ground so that we could feed them. They were grooming and playing when the barking of a dog caused the guttural alarm note of the male overlord. At once all monkeys climbed the nearby trees or house roofs.

## 5. SOME PROBLEMS WHICH COULD EASILY BE WORKED OUT IN INDIA

Our review shows that rather little is known about the natural life of Indian monkeys. For Indian zoologists it would perhaps not be too difficult to solve many open questions. The most important of them seem to be the following:

1. Exact counting of individuals in monkey troops near villages and temples, and also in the jungle far away from human influence.
2. Statement of the number of adult males and females, juveniles, infants and babies per troop.
3. Determination of the months in which babies are born all over India.
4. Analysing of large troops to ascertain if they consist of stable family parties.
5. Investigation of the size of the territory of monkey troops.
6. Correlating the size of the territory with the size of the troop and perhaps with the amount of food available.
7. Observation whether there is any defending of the territory against troops of the same or different species.
8. Observing whether monkeys move more or less from tree to tree or on the ground.
9. Noting how often the monkeys drink during the day.
10. Observing how long they sleep during the night, and whether the sleeping place is more or less permanent.

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# THE BOTANICAL EXPLORATION OF THE KRISHNAGIRI NATIONAL PARK, BORIVLI, NEAR BOMBAY

BY

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AND

ABAN J. RANDERIA, M.SC.

(*With two maps, one coloured and two black-and-white plates*)

## INTRODUCTION

The Krishnagiri National Park is one of the many developments that have taken place in our Bombay State after Independence. Being so near Bombay, the Park is a centre of great attraction to picnickers and visitors, who can now visit the renowned Kanheri Caves in relative comfort. It is, however, of much greater interest to students of botany who find, within the confines of the Park, everything that is best in the botany of Bombay State. Among the non-botanical visitors there are many, too, who feel greatly attracted towards the flowers and trees that cover most of the ground from Borivli Station to the Caves themselves, and on the rocky ground above the Caves. To help either group of visitors the present work was undertaken; this paper is but a summary of our results.

In view of the small area of the Park, it was at first suggested that a single research worker be put to work out the whole flora of the Park; but it soon became evident that the task was much too great for the 2-3 years at our disposal. For this reason our attention was concentrated on the flowering plants of the Park, with special emphasis on the Gamopetalous Phanerogams of the same. To help in the concentrated study of the flora of the National Park, the junior author was given a scholarship by the Bombay Natural History Society; it is in token of recognition that this summary of the work is offered to the public through the pages of this journal.

## GEOGRAPHICAL POSITION OF THE KRISHNAGIRI NATIONAL PARK

The Park covers an area of roughly 12 sq. miles (19·2 sq. km.). It is situated in Salsette Island due North of Bombay City, and at a distance of 20 miles (32 km.) from Flora Fountain in Bombay.

Access may be had to the Park by the Western Railway, via Borivli Station; by road, it is possible to go from Bombay City to Borivli via Andheri along the Ghodbunder Road. From Borivli, if going by train, one leaves the station and moves due East; about half a mile from the station is the entrance to the Park; thereafter there is a good road that traverses the Park from W. to E. through its almost entire length. It is also possible to go by train up to Kandivli, and then by a footpath that crosses the low range of hills that form the South boundary of the Park, one may go up to the Caves; there is no motorable road from Kandivli. For those desirous of a fine walk through the hills, there is another and more difficult path from Bhandup Station, on the Central Railway, and then across the hills that flank Tulsi Lake, to Kanheri Caves. At any rate, the walk from Borivli Station or from the other starting points to the Caves themselves is only about 6 miles long.

## GENERAL DESCRIPTION OF THE TERRAIN

The Krishnagiri National Park consists of that part of the country in Salsette Island which lies on either side of the Dahisar River; the latter with most of its affluent streams is almost entirely enclosed within the Park boundaries.

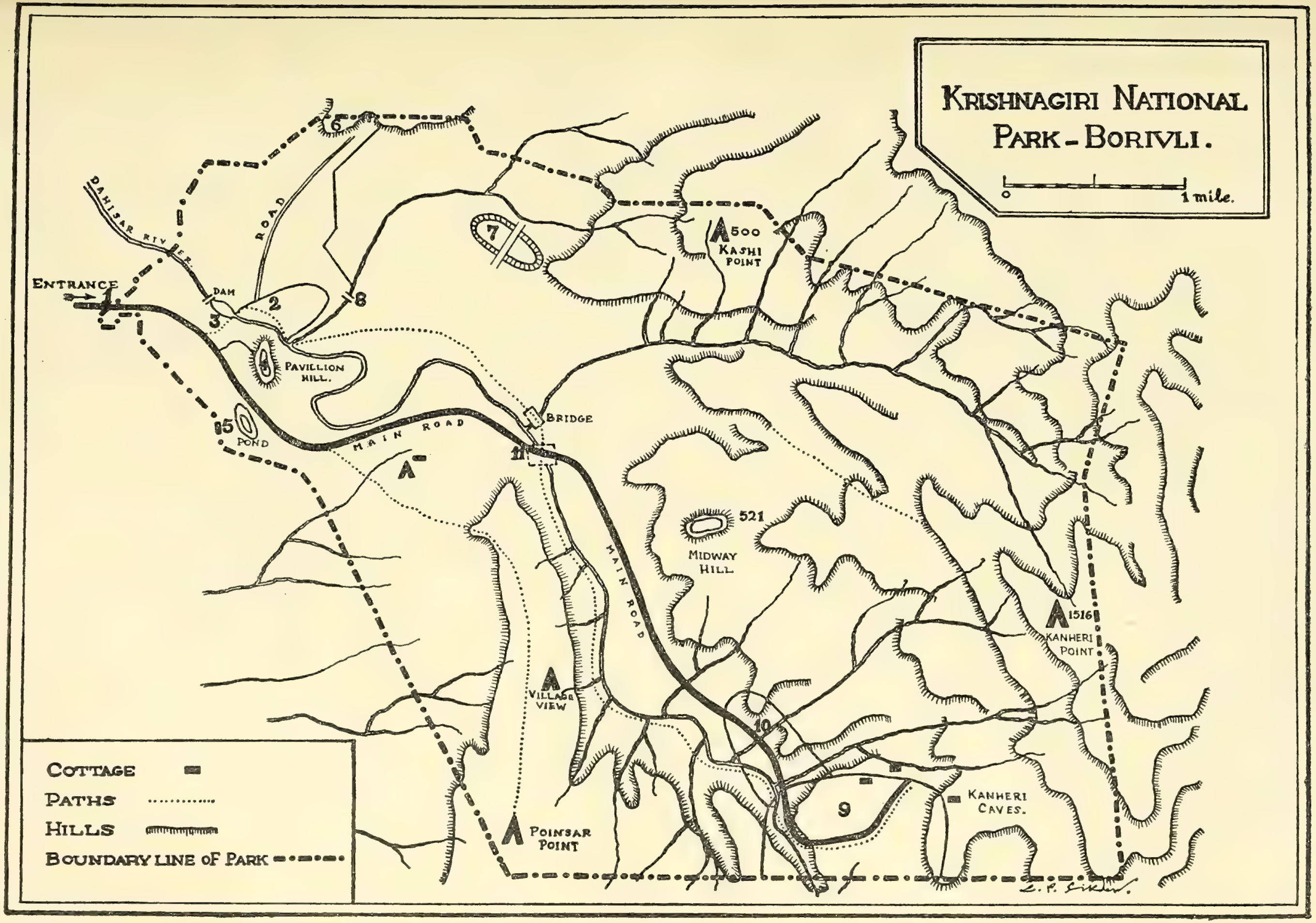
The district is made up of a central valley along which the main road and the main channel of Dahisar River run almost parallel to each other, at least for some distance. On the other side of the road the country is hilly, there being 2 main chains of hills running in the same general direction, W. to E., as the road and the river; at the farthest eastern part of the Park boundaries, the southern chain of hills turns upwards and joins the northern one, so that the Park is almost completely enclosed within a horse-shoe shaped range of hills.

Kanheri Point is the highest part of the district, rising up to 1516 ft. (455 m.) above sea level; on the hills there are a number of plateaus and vantage points, which, in the accompanying map have been marked with Λ.

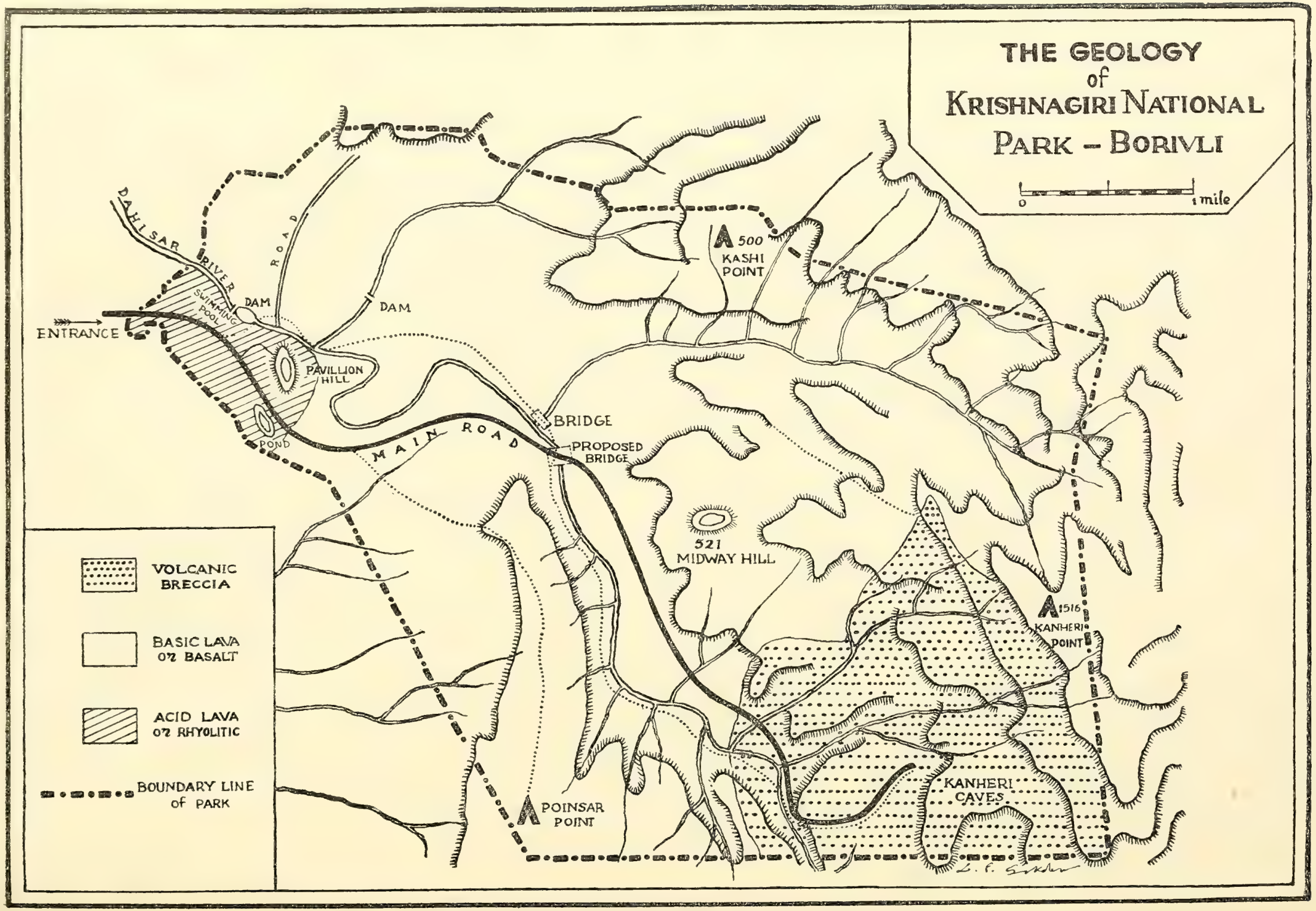
## CLIMATIC DATA

For the climatic data herein given, we are indebted to the Director-General of Observatories, Poona, by whose kind permission, the data are here reproduced. We have not been able to obtain, either personally or from official sources, data directly concerning the National Park. The metereological station nearest to Borivli is the one at Santa Cruz, Bombay North, which is only about 9–10 miles south of Kanheri Caves.

The climatic conditions, however, differ little between Borivli and Santa Cruz, except perhaps at the higher parts of the Park where the temperature may be slightly lower and the wind velocity together with the rainfall, slightly higher. The difference, however, seems to be small and for practical purposes negligible.


KRISHNAGIRI NATIONAL PARK - BORIVLI.
0
1 mile.
ENTRANCE
DAHISAR RIVER
DAM
ROAD
1
2
3
4
5
6
7
8
9
10
11
PAVILLION HILL.
POND
BRIDGE
MAIN ROAD
MAIN ROAD
500 KASHI POINT
521
MIDWAY HILL
1516 KANHERI POINT
VILLAGE VIEW
POINSAR POINT
KANHERI CAVES.
COTTAGE
PATHS
HILLS
BOUNDARY LINE OF PARK

1. Entrance Gate, 2. Administrative Offices, 3. Swimming Pool, 4. Pavilion Hill, 5. Pond, 6. Holiday Camp Hill, 7. Model Village, 8. Dam and Waterfall, 9. Slopes below Caves, 10. *Acacia-Trewia* area, 11. Proposed bridge over main stream.


THE GEOLOGY
of
KRISHNAGIRI NATIONAL
PARK – BORIVLI
0
1 mile
DAHISAR RIVER
ENTRANCE
SWIMMING POOL
DAM
ROAD
DAM
PAVILLION HILL
POND
MAIN ROAD
BRIDGE
PROPOSED BRIDGE
500
KASHI POINT
521
MIDWAY HILL
1516
KANHERI POINT
KANHERI CAVES
POINSAR POINT
VOLCANIC BRECCIA
BASIC LAVA OR BASALT
ACID LAVA OR RHYOLITIC
BOUNDARY LINE of PARK

The climatic data incorporated in this paper cover a period of 7 years, from 1946–1952. In our outings we have occasionally taken readings for temperature, wind velocity, light intensity etc.; our readings, however, are not mentioned here because they are too sporadic to be of any scientific value; nevertheless on checking our readings with the official data here reproduced, we find them in very close agreement, and this further prompts us to leave our insufficient readings out of the picture.

## RAINFALL

The rainy season in Borivli, as well as in Bombay, lasts roughly from about the middle of June to the end of September. The advent of the SW. monsoon is heralded by some severe local thunderstorms from the end of May onwards. The monsoon proper sets in at about the middle of June and continues, usually with great force, up to the end of August. Thereafter there may be a short break of clear, sunny days. The NW. monsoon starts about the end of the first week in September and continues more or less regularly till the end of the month. Occasionally a few heavy showers come down at the beginning of October. From about the middle of October onwards, till the next monsoon, the rainfall may be reduced to just an occasional light shower particularly towards the end of December.

Of the total amount of rainfall recorded for the district, the greatest percentage belongs to the period June—October. The rainfall for the rest of the year may go up to about 5% of the total yearly figure.

The following table gives the total annual rainfall for the years 1946–1952 in inches and cm.; the highest rainfall was that for 1949 with a total of 108·51″ (271·42 cm.), and the lowest that for 1950 with only 61·50″ (153·75 cm.). The average for the period 1946–1952 is 75·95″ (189·87 cm.).

TABLE 1.

TOTAL ANNUAL RAINFALL

1946–1952

| Year | Total in inches | Total in cm. | Remarks |
|---|---|---|---|
| 1946 | 79·14 | 197·85 | ...... |
| 1947 | 77·08 | 192·70 | ...... |
| 1948 | 71·74 | 179·35 | ...... |
| 1949 | 108·51 | 271·42 | Highest in 6 years. |
| 1950 | 61·50 | 153·75 | Lowest in 6 years. |
| 1951 | 70·41 | 176·02 | ...... |
| 1952 | 63·33 | 158·32 | ...... |

The following table gives the average monthly rainfall for the years 1946–1952 in inches and cm.

TABLE 2

AVERAGE MONTHLY RAINFALL
1946–1952

| Month | Rainfall ins. | Rainfall cm. |
|---|---|---|
| January ... | 0·048 | 0·12 |
| February ... | ... | ... |
| March ... | 0·016 | 0·04 |
| April ... | 0·37 | 0·92 |
| May ... | 0·43 | 1·07 |
| June ... | 15·35 | 38·37 |
| July ... | 25·08 | 62·70 |
| August ... | 12·40 | 31·00 |
| September ... | 18·63 | 46·57 |
| October ... | 1·93 | 4·82 |
| November ... | 1·59 | 3·97 |
| December ... | 0·087 | 0·21 |

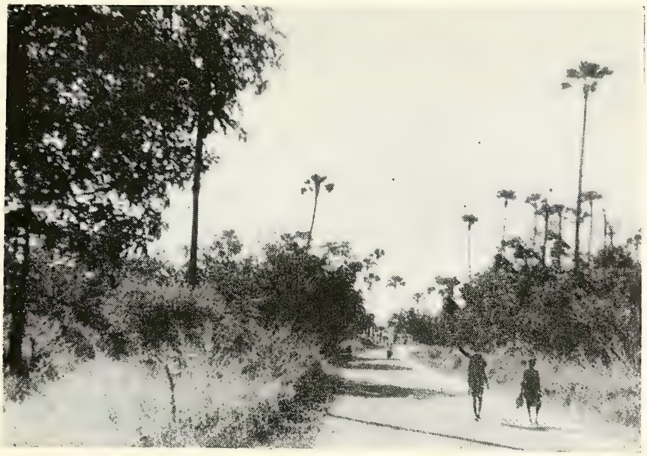
### SUNSHINE

The length of daily sunshine varies according to the season and weather. During the monsoon, which corresponds to the longest days of the year, the amount of sunshine is the smallest due to the presence of dense clouds. A study of the monthly record of sunshine from 1933–1942 shows that July is the month with the shortest period, the length of the sunshine period increasing gradually as we move in either direction from July ; the maximum length of sunshine is that of May.

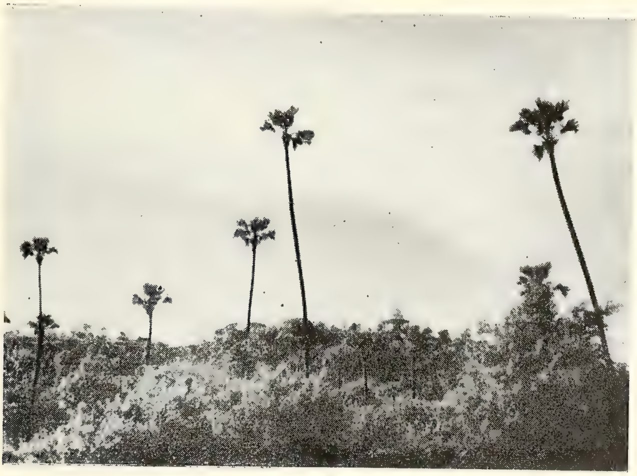
TABLE 3

MONTHLY TOTAL DURATION OF SUNSHINE
(Average for 1933–1942)

| Month | Jan. | Feb. | March | April | May | June |
|---|---|---|---|---|---|---|
| Hours | 298·8 | 281·6 | 302·1 | 303·7 | 321·6 | 159·4 |

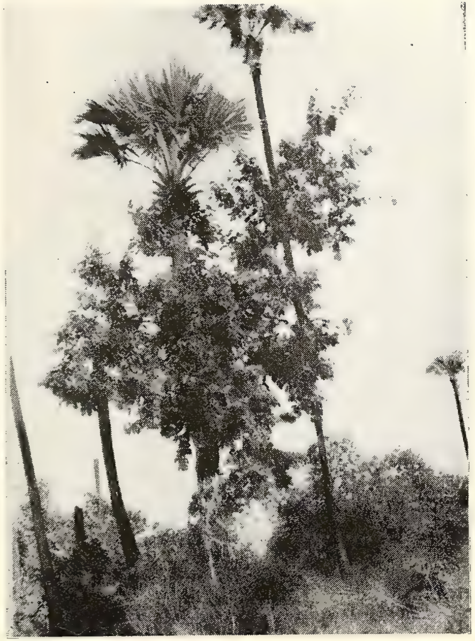


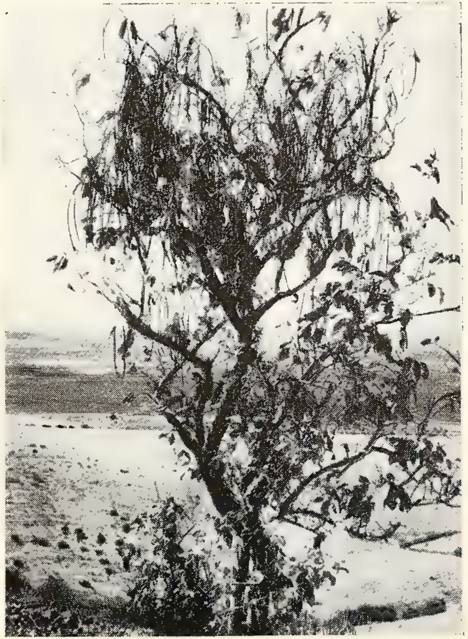
1. View of the main road near the entrance to the National Park.



2. The vegetation on the slopes of Gandhi Smriti Mandir at the entrance to the Park.

*(Photos: H. Santapau)*





*Photos* *H. Santapau*

1. The strangler fig *(Ficus bengalensis)* on the Tad palm, *(Borassus flabellifer)*.

2. *Wrightia tinctoria* in fruit.

| Month | July | August | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|
| Hours | 67·4 | 93·2 | 172·7 | 268·5 | 282·3 | 287·9 |

### TEMPERATURE

The hottest months of the year are April and May, October being a close second. The maximum temperature recorded for the years 1946–1952 is 92·7°F. (33·7°C.). The hottest hours of the day are between 12 noon and 3 p.m. The coolest month of the year is January with an average minimum of about 70°F. (21·1°C.). The lowest minimum temperature registered for the same years as above is 65·2°F. (18·44°C.). The range of daily temperature for any month of the year is about 15°F. (8·3°C.); in the monsoon, however, the difference is scarcely ever more than 10°F. (5·5°C.).

TABLE 4

MEAN MONTHLY MAXIMUM AND MINIMUM TEMPERATURES IN °F.
1946–1952

| Month | Mean Maximum | Mean Minimum |
|---|---|---|
| January ... | 85·075 | 67·03 |
| February ... | 85·44 | 68·24 |
| March ... | 88·21 | 72·78 |
| April ... | 90·04 | 77·33 |
| May ... | 92·00 | 80·60 |
| June ... | 89·53 | 79·53 |
| July ... | 85·94 | 77·65 |
| August ... | 85·55 | 76·01 |
| September ... | 86·01 | 76·18 |
| October ... | 89·21 | 76·43 |
| November ... | 89·54 | 72·80 |
| December ... | 87·43 | 69·18 |

Mean yearly temperature : 81·17°F.
Mean maximum temperature : 87·83°F.
Mean minimum temperature : 74·48°F.
Highest maximum temperature for 7 years : 92·7°F. in May 1952.
Lowest minimum temperature for 7 years : 65·2°F. in Jan. 1951.

## HUMIDITY

Due to its proximity to the sea, the moisture content of the air at the National Park remains fairly high throughout the year. There are slight changes from season to season; in the monsoon, the moisture content may reach close to 100 and seldom goes below 80%. In the dry season, especially in the months of February and March, the moisture content goes down to 60%. In addition to this seasonal change, there is a daily variation, the relative humidity being high in the early hours of the morning, decreasing to a minimum at about 3 p.m. and thereafter going up through the evening and night to the maximum of early morning.

TABLE 5

RELATIVE HUMIDITY OF THE ATMOSPHERE

Average for 1946–1952

| Month | Humidity % at 08·00 hrs. I.S.T. | Humidity % at 17·00 hrs. I.S.T. |
|---|---|---|
| January ... | 72·1 | 63·4 |
| February ... | 74·1 | 61·3 |
| March ... | 73·7 | 62·4 |
| April ... | 73·8 | 65·7 |
| May ... | 73·8 | 66·0 |
| June ... | 81·7 | 75·7 |
| July ... | 86·8 | 82·7 |
| August ... | 86·3 | 81·5 |
| September ... | 86·4 | 79·0 |
| October ... | 78·5 | 74·0 |
| November ... | 73·8 | 68·3 |
| December ... | 71·1 | 63·7 |

Mean annual humidity at 08·00 hrs. I.S.T.: 77·6%.
Mean annual humidity at 17·00 hrs. I.S.T.: 70·2%.

## WIND DIRECTION AND VELOCITY

The general direction of the wind throughout the dry months of the year is from North or the North-east. During the first half of the monsoon, from June to about the end of August, the winds blow from

South-west to North-east, at times with considerable force; during September and the early part of October, the winds change into a North-west to South-east direction and are generally considerably slower than in the early part of the monsoon. Occasionally we have had gales reaching a speed of about 90 m.p.h. (November 22, 1948). During the dry months of the year, there is usually a gentle breeze blowing from the sea inwards and lasting from about 11 a.m. to about 3 p.m.

In general, climatic conditions in the National Park are very similar to those in Bombay with a few noteworthy differences. In the low-lying ground along the river and road in the Park, the temperature may be rather unpleasant at noon, the reason being that the hills forming the boundary of the Park enclose the area and keep out much of the breeze. On the other hand, the higher parts near the Kanheri Caves are considerably cooler than Bombay, and during the monsoon receive a larger quantity of rainfall than the plains or the rest of Salsette and Bombay Islands. In spite of the high temperatures mentioned above, the Park remains fairly covered with green plants through the greater part of the year; the probable cause for this seems to be the abundance of water in the district and the high moisture content of the atmosphere.

## Geological Data

There is little that can be said about the geology of the Krishnagiri National Park that does not apply to most of Salsette Island. The general type of rock of the whole area must be classed as 'Deccan Trap'. Such rocks are thought to have been formed as the result of volcanic action; they are generally rather dark, almost black, in colour and fairly hard. However, in the area under consideration, three distinct types of volcanic rocks have been observed:

(1) Volcanic breccia,
(2) Basic lavas or basalt,
(3) Acid lavas or rhyolitic.

The Kanheri Hills in which the Caves have been carved show a dome-shaped structure and are chiefly made of volcanic breccia; this type of rock is practically restricted to the part of the hills in the neighbourhood of the Caves. The soil cap on this type of rock is either very thin or altogether absent. It is, therefore, impossible to have large trees on such ground except in depressions where the soil has gathered, or in large cracks in the rocks. The rocks are impervious to water.

The hills forming the arms of the horse-shoe, of which Kanheri is the centre, are made of basalt or basic lava. This type of rock covers the larger portion of the area. Soil is fairly abundant specially in the low-lying parts where soil brought down by the rains is gathered. The rocks themselves are very dark, almost black, but the soil may at times be rather reddish on account of the high concentration of iron.

The third type of rock is found from close to the railway station of Borivli to Pavillion Hill and extends northwards up to Dahisar River. The contrast between these two types—acid and basic lavas—can be clearly seen along the channel of Dahisar River.

## The Vegetation of Krishnagiri National Park

As stated above, the entrance to the Park is about ½ mile E. of Borivli Station. Just within the Park, and near its entrance, is situated the National Park Hotel and a little further into the Park, the Administrative Offices, Recreation Ground, etc. The first hill encountered when entering from Borivli is Pavillion Hill (No. 4 in the map) from which a good view may be had of practically the whole of the Park. The slopes of Pavillion Hill are botanically very interesting; the trees and shrubs are decidedly of the Southern Tropical Moist Deciduous Type of Champion. Going further into the Park along the main road, the country is intensively cultivated in spots, rice being the main crop; *Borassus flabellifer* Linn. is the most common tree in this part, in or near the cultivated fields.

The central valley, along which the road and river run, is practically bare of vegetation except in the immediate neighbourhood of the river. The altitude of the valley is about 15 ft. above sea level. The banks and bed of the river show the vegetation typical of such habitats. The banks of the river are often covered with woody plants such as *Holarrhena antidysenterica* Wall., *Mangifera indica* Linn., *Woodfordia fruticosa* Kurz., *Kirganelia reticulata* Baill., *Homonoia riparia* Lour., *Pongamia pinnata* Pierre, *Syzygium cumini* Skeels, etc. *Pongamia pinnata* Pierre becomes particularly common along the river at the part where the ground begins to rise, until in the higher reaches, it becomes a large tree and covers the banks to the exclusion of almost everything else.

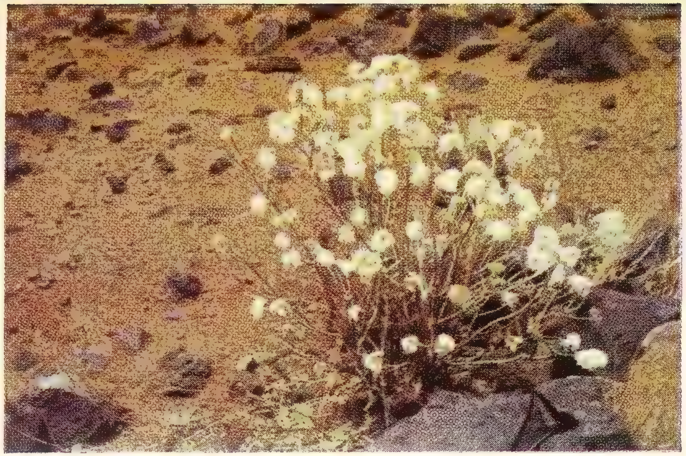
Climbing on the shrubs of the river banks we have noticed, among the commonest, the following plants: *Derris scandens* Benth., *Combretum ovalifolium* Roxb., *Argyreia nervosa* Boj., *Smilax zeylanica* Linn., *Jasminum malabaricum* Wt.

In the bed of the river, during the dry months of the year, the commonest plants are *Rotula aquatica* Lour. and *Homonoia riparia* Lour. Near the water or in very moist places *Polygonum glabrum* Willd. grows in great abundance. In drier parts, *Glinus lotoides* Linn., *Argemone mexicana* Linn., *Coldenia procumbens* Linn., etc. grow in fairly good abundance.

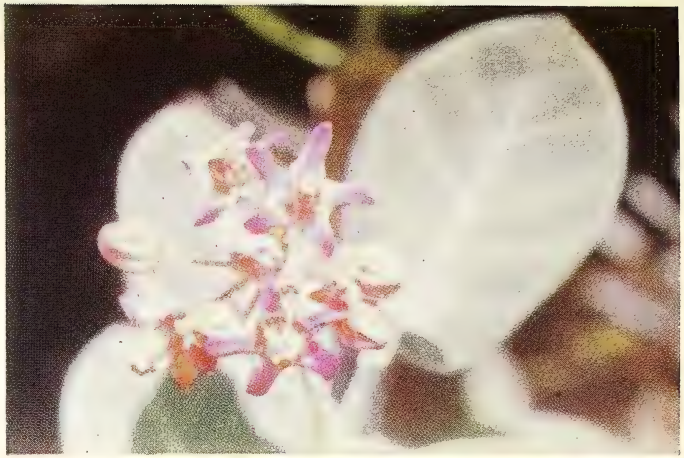
Scattered on either side of the main road, there are a number of pools which show an almost constant composition in vegetation. *Ipomoea aquatica* Forsk. grows in water or in very wet soil; *Utricularia stellaris* Linn. and *Limnophila sessiliflora* Blume grow submerged in water except for the inflorescence; *Nymphaea pubescens* Willd., *Limnanthemum cristatum* Griesb., *Limnanthemum indicum* Thw., *Azolla* and others float on the surface. After the disappearance of the water, but before the ground becomes dry, one finds an abundance of *Grangea maderaspatana* Poir., *Coldenia procumbens* Linn., *Sphaeranthus indicus* Linn., *Polygonum plebejum* R. Br., *Glinus lotoides* Linn., *Dopatrium junceum* Buch.-Ham., *Hydrolea zeylanica* Vahl, several species of *Lindernia* and a large number of *Cyperaceae* and *Gramineae*; often semi-parasitic species of *Scrophulariaceae* grow on the roots of such grasses.

### Vegetation along the Main Road

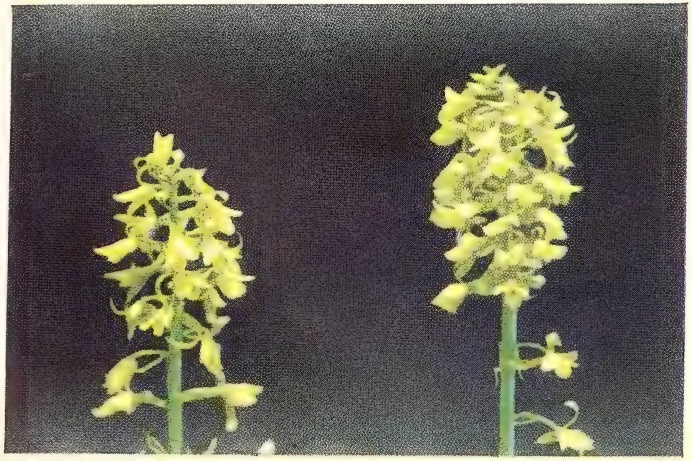
The vegetation on the road itself, during the dry months of the year, is typically of a strongly xerophytic type and includes many of the weeds



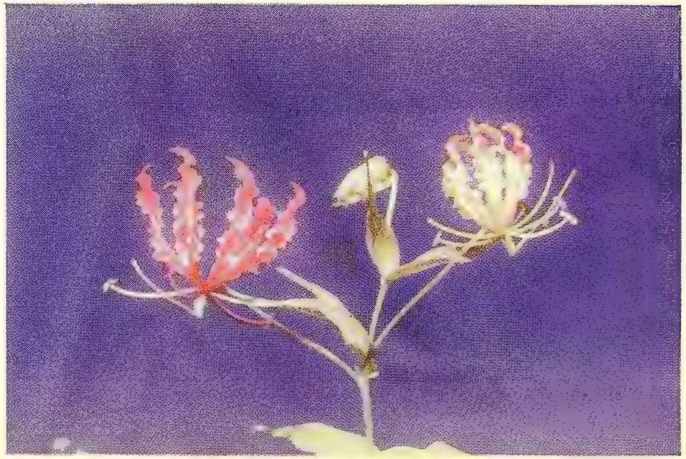
1. *Pavetta indica* Linn. from the plains.



3. *Calotropis gigantea* R. Br. from open bare ground along the plains.



2. *Eulophia ochreata* Lindl. from the rocks above the Caves.



4. *Gloriosa superba* Linn. from grass fields along the plains.

Photos H. Santapau.

seen in similar habitats in the neighbourhood of Bombay. Among the commoner plants are the following:

*Euphorbia hirta* Linn.
*Euphorbia thymifolia* Linn.
*Phyllanthus simplex* Retz.
*Phyllanthus urinaria* Linn.

and several species of prostrate *Alysicarpus* and *Desmodium*.

On many occasions we have noticed several alien plants on the road, showing thereby the means of introduction of the same into the district. Such, for instance, are *Gomphrena celosioides* Mart., *Acanthospermum hispidum* DC. and others.

Along the sides of the road one sees the same plants as on the road itself, but growing more luxuriantly, and in addition are the following plants given roughly in the order of abundance:

*Hyptis suaveolens* Poit.
*Celosia argentea* Linn.
*Sesamum indicum* Linn.
*Vernonia cinerea* Less.
*Achyranthes aspera* Linn. var. *porphyristachya* Hook. f.
*Physalis minima* Linn.
*Peristrophe bicalyculata* Nees.
*Cleome viscosa* Linn.
*Cassia mimosoides* Linn.
*Aeschynomene indica* Linn.
*Martynia annua* Linn.
*Solanum xanthocarpum* Schrad. et Wendl.
*Cassia tora* Linn.

Among the foreign or cultivated plants being introduced into the district, the following are noticeable:

*Acanthospermum hispidum* DC.
*Lycopersicon esculentum* Mill.
*Xanthium strumarium* Linn.
*Hyptis suaveolens* Poit.
*Physalis peruviana* Linn.
*Gomphrena celosioides* Mart.
*Sesamum indicum* Linn.
*Martynia annua* Linn.

Some of these plants, e.g. *Acanthospermum*, are now well established within the entrance to the Park; unless measures are taken to check it, this weed, within a few years, may spread all over the National Park.

## The Hills along the Main Road

The vegetation of the hills N. and S. of the main Park road is clearly of secondary formation; the original forest has almost completely disappeared from the whole Park area. The regenerated forest has also been subjected to much despoliation, so that, in consequence, it is very rare now to find a tree over 50 feet in height.

The forest, or whatever is left of it, can be roughly classed in the 'Southern Tropical Moist Deciduous Forest' or 'Deciduous Monsoon Forest' Type of Champion. In many parts of the so-called forest, only shrubs of up to 8–10 feet remain. Even in better parts of the forest, it is not easy to distinguish the various storeys or layers which are so typical in other parts of the country. Where such storeys can be distinguished, the following is their composition:

(*a*) Top Layer (30–50 ft. in height):

The commonest trees forming this storey are the following:

*Terminalia crenulata* Roth.
*Garuga pinnata* Roxb.
*Tectona grandis* Linn. f.
*Bridelia squamosa* Gehrm.

*Butea monosperma* Kuntze.
*Bauhinia racemosa* Lamk.
*Ficus gibbosa* Blume var. *parasitica* King.
*Mallotus philippensis* Muell-Arg.
*Adina cordifolia* Bth. and Hk.
*Oroxylum indicum* Vent.
*Kirganelia reticulata* Baill.

(*b*) Middle Layer (6–15 ft.):

This layer is made up of seedlings of the plants forming the upper layer and of a few woody plants among which the following are common:

*Wrightia tinctoria* R. Br.
*Holarrhena antidysenterica* Wall.
*Zizyphus glaberrima* Sant.
*Helicteres isora* Linn.
*Pavetta indica* Linn.
*Grewia tiliaefolia* Vahl.
*Grewia microcos* Linn.
*Morinda tinctoria* Roxb. var. *tomentosa* Hook. f.
*Melanthesa turbinata* Wight.
*Carvia callosa* Bremek.
*Solanum indicum* Linn.
*Anisomeles heyneana* Benth.

(*c*) Ground Layer:

This is made up of grasses and a few herbaceous species none of which, however, is sufficiently common in the dry season to give a distinctive appearance to this layer. The commoner plants are: *Hemigraphis latebrosa* Nees var. *heyneana* Bremek., *Haplanthus tentaculatus* Nees var. *neesiana* Sant., *Orthosiphon glabratus* Benth., and others.

(*d*) Climbers:

Scattered all over the forest and going at times over the highest trees are the following climbers:

*Aspidopterys cordata* A. Juss.
*Dalbergia volubilis* Roxb.
*Jasminum malabaricum* Wight.
*Combretum ovalifolium* Roxb.
*Cryptolepis buchanani* R. & S.
Species of *Cissus* and *Ampelocissus*.
*Derris scandens* Benth.
*Cylista scariosa* Roxb.
*Zizyphus rugosa* Lamk.
*Cansjera rheedii* Gmel.
*Pueraria tuberosa* DC.
*Argyreia nervosa* Boj.

Scattered all over the forest one also finds a large number of bamboos (*Bambusa bambos* Voss.) in massive clumps. On the southern hills, the bamboos occur in relatively small clumps scattered more or less over the hills. On the northern side of the road, large stretches have been taken over by the bamboo to the exclusion of almost everything else.

Most of the trees forming the vegetation of the northern and southern hills are deciduous. There are, however, a number of evergreen plants more or less restricted to the middle layer, which are not sufficiently common or abundant to change the deciduous appearance of the forest. Further, we have observed that although the individual components of the forest may be deciduous, yet the forest never reaches that stage of nakedness which one sees in the districts round Poona and further in the Deccan. The reason for this is that the trees on our hills shed their leaves at different times so that, in general, all through the year one can see plenty of green foliage even in the so-called deciduous forest.

### THE VEGETATION ABOVE THE CAVES

The vegetation above the Caves is scanty owing principally to the scarcity of soil and water. The ground is practically bare rock with but a few cracks where a small amount of soil gives some hardy plants a very precarious foothold. In the higher reaches, up to the very highest point, the soil is also scanty and so is the vegetation. Among the trees or shrubs noted on the higher parts above the Caves, the following may be metioned:

*Sterculia urens* Roxb.
*Salmalia insignis* Schott. & Endl.
*Lannea grandis* Engler.
*Hymenodictyon excelsum* Wall.
*Hymenodictyon obovatum* Wall.
*Gardenia lucida* Roxb.
*Tectona grandis* Linn.
*Nyctanthes arbor-tristis* Linn.
*Holoptelea integrifolia* Planch.
*Carvia callosa* Bremek.
*Barleria lawii* Anders.
*Haplanthus verticillatus* Nees.

There are some common climbers growing on these trees, among them the commonest being *Tinospora cordifolia* Miers. and *Smilax zeylanica* Linn.

On the higher ground above the Caves, there are several natural or artificial tanks or pools which keep some of their water well into the dry season; the soil in such tanks retains its moisture much longer. We have noticed a number of hygrophytic plants growing in such pools in the dry season, among which the following are among the commonest and most abundant:

*Portulaca oleracea* Linn.
*Mollugo oppositifolia* Linn.
*Gnaphalium indicum* Linn.
*Sphaeranthus indicus* Linn.
*Ageratum conyzoides* Linn.
*Fimbristylis aestivalis* Vahl.
*Cyperus pygmaeus* Rottb.
*Cyperus iria* Linn.

### SLOPES BELOW THE CAVES

In the slopes immediately below the Caves, there are several densely wooded spots some of which in character seem to approach the evergreen forest. The height of the tallest trees in such spots is up to 45 feet (13·5m.); the layers or storeys which we find in the wetter parts of Bombay State are not clear in this locality. There is a mixture of trees between about 10 and 45 feet, but the trees are not grouped or divided in any way according to heights. The following list mentions the commoner trees or tree-like plants found on the slopes below the caves and the arrangement in roughly what we think is the order of abundance:

*Dalbergia latifolia* Roxb.
*Morinda tinctoria* Roxb. var. *tomentosa* Hook. f.
*Wrightia tinctoria* R. Br.
*Helecteres isora* Linn.
*Trema orientalis* Blume.
*Bridelia squamosa* Gehrm.
*Tectona grandis* Linn. f.
*Salmalia malabarica* Schott. & Endl.
*Lannea grandis* Engler.
*Kydia calycina* Roxb.
*Bambusa bambos* Voss.
*Zizyphus glaberrima* Sant.
*Erythrina variegata* Linn. var. *orientalis* Merrill.

*Acacia suma* Buch.-Ham.
*Adina cordifolia* Bth. & Hk.
*Butea monosperma* O. Kuntze.
*Mallotus philippensis* Muell-Arg.
*Trewia polycarpa* Benth.
*Grewia microcos* Linn.
*Melanthesa turbinata* Wight.
*Lagerstroemia lanceolata* Wall
*Terminalia crenulata* Roth.
*Garuga pinnata* Roxb.
*Tamarindus indica* Linn.
*Holarrhena antidysenterica* Wall.

The ground vegetation on the slopes below the Caves is practically non-existent throughout the dry season. Among the smaller plants in such spots the following are fairly common :

*Solanum indicum* Linn.
*Neuracanthus trinervius* Wt.
*Hibiscus hirtus* Linn.
*Anisomeles heyneana* Benth.

The climbers on the large trees in these spots are showy either because of their flowers or because of the size and shape of their leaves. The commonest among them are :

*Dalbergia volubilis* Roxb.
*Jasminum malabaricum* Wight
*Combretum ovalifolium* Roxb.
*Calycopteris floribunda* Lamk.
*Cryptolepis buchanani* R. & S.
*Argyreia nervosa* Boj.
*Dioscorea hispida* Dennst.
*Cylista scariosa* Roxb.
*Cansjera rheedii* Gmel.
*Zizyphns rugosa* Lamk.
*Zizyphus oenoplia* Mill.
*Smilax zeylanica* Linn.
*Cissus repanda* Vahl.
*Ampelocissus latifolia* Planch.

Coming down the slopes a little further, (No. 9 on map) there is a spot where *Acacia suma* Buch.–Ham. and *Trewia polycarpa* Benth. are so abundant as to be dominant at least along the road ; the forest is very thin and much smaller than in the previous part but here we have noticed a number of interesting trees which are somewhat rare elsewhere. Among them mention must be made of

*Adina cordifotia* Bth. & Hk.
*Salmalia malabarica* Schott. & Endl.
*Butea monosperma* O. Kuntze.
*Ficus glomerata* Roxb.
*Ficus hispida* Linn.
*Bridelia squamosa* Gehrm.
*Dalbergia latifolia* Roxb.
*Cassia fistula* Linn.
*Lagerstroemia lanceolata* Wall.
*Sterculia foetida* Linn.
*Bambusa bambos* Voss.
*Acacia suma* Buch.–Ham.
*Trewia polycarpa* Benth.
*Oroxylum indicum* Vent.
*Wrightia tinctoria* R. Br.
*Zizyphus glaberrima* Sant.
*Grewia tiliaefolia* Vahl.
*Morinda tinctoria* Roxb.
  var. *tomentosa* Hook. f.
*Melanthesa turbinata* Wight.
*Lantana camara* Linn.
  var. *aculeata* Moldenke.
*Helicteres isora* Linn.
*Calotropis gigantea* R. Br.

Among the climbers we have noticed again *Derris scandens* Benth., *Aspidopterys cordata* Juss., *Dioscorea hispida* Dennst., *Smilax zeylanica* Linn., *Argyreia nervosa* Boj. and others.

### Changes induced by the Monsoon

After the first few showers towards the end of May or the beginning of June, several bulbous plants of the families *Amaryllidaceae, Liliaceae* and *Scitaminaceae* come into flower, even before the leaves appear above the ground. Commonest among such plants are *Curculigo orchioides* Gaertn., *Crinum latifolium* Linn., *Curcuma inodora* Blatt., *Pancratium parvum* Dalz., *Scilla hyacinthina* MacBride and others like *Dioscorea oppositifolia* Linn. and *Amorphophallus* sp.

Soon after that, in about a week or two, the whole ground, in open places, becomes carpeted with a variety of sprouting grasses which cover the whole surface with a vivid green.

Throughout the rains, in the undergrowth of the forest, there are hardly any changes except for a variety of fungi and occasional plants of *Aeginetia indica* Linn., *Curcuma inodora* Blatt., *Murdannia scapiflorum* Royle, *Tacca pinnatifida* Forst., *Amorphophallus* sp.

On the edges of the forest, however, numerous plants typical of the rains begin growing, and by about the middle of the monsoon the following plants are among the commonest:

*Melothria maderaspatana* Cogn.
*Melothria heterophylla* Cogn.
*Cucumis callosus* Cogn.
*Trichosanthes bracteata* Voigt.
*Momordica dioica* Roxb.
*Luffa acutangula* Roxb. var. *amara* C. B. Clarke.
*Neuracanthus sphaerostachyus* Dalz.
*Thunbergia fragrans* Roxb.
*Asystasia dalzelliana* Sant.
*Sopubia delphinifolia* G. Don.
*Striga asiatica* Kuntze.
*Eranthemum purpurascens* Nees.
*Asteracantha longifolia* Nees.
*Barleria prattensis* Sant.
*Haplanthus tentaculatus* Nees. var. *neesiana* Sant.
*Haplanthus verticillatus* Nees.
*Hemigraphis latebrosa* Nees. var. *heyneana* Bremek.
*Rungia pectinata* Nees.
*Rostellularia procumbens* Nees.
*Costus speciosus* Sm.
*Rhamphicarpa longiflora* Benth.
*Murdannia scapiflorum* Royle.
*Lindernia*—several sp.

In open places, in addition to the grasses, the ground is covered by species of Papilionaceae and other Leguminosae, Rubiaceae, Compositae, etc. Common among these are:

*Desmodium*—several spp.
*Alysicarpus*—several spp.
*Crotalaria*—several spp.
*Teramnus labialis* Spr.
*Aeschynomene indica* Linn.
*Smithia*—several spp.
*Cassia absus* Linn.
*Cassia tora* Linn.
*Fleurya interrupta* Gaud.
*Sesamum indicum* Linn.
*Martynia annua* Linn.
*Anotis foetida* Bth. & Hk.
*Borreria stricta* K. Schum.
*Borreria hispida* K. Schum.
*Senecio grahami* Hook. f.
*Tridax procumbens* Linn.
*Ageratum conyzoides* Linn.

On the rocks above the Caves, the commonest plants during the rains are *Dipcadi saxorum* Blatt., *Eulophia ochreata* Lindl., *Utricularia striatula* Sm., *Begonia crenata* Dryand., *Ophioglossum* sp., *Eriocaulon* sp. etc.

On more or less vertical rock walls we have noticed some grasses and other plants. Among them are *Tripogon* sp., *Arthraxon* sp., and a multitude of algae, fungi and bryophytes; vertical walls towards the end of the monsoon are practically covered with a dense green mantle of vegetation. The upper slopes above the Caves become very slippery on account of such plants, particularly the cryptogams.

Even such parts of the forest as are apparently less affected by the monsoon become covered with a luxuriant growth of climbers and other large-leaved plants which finally give the forest the appearance of the densely evergreen forest of the south of our State.

## DISTRIBUTION OF OUR PLANTS

The following list has been compiled so as to show the origin of the plants composing the flora of the Krishnagiri National Park, Borivli. As is well known, Bombay State has three very distinct elements in its flora—one coming from the Malayan region, another from North-eastern and Central India and a third one from North Africa through Asia Minor.

It will also be observed that some plants are endemic to Bombay State and so far have not spread to other parts of India. Other plants are common to Bombay and South India, and so on. In tabular form, our results may be summarized thus. The first column shows the distribution of the plants in various parts of the world. The second column gives the number of species for each group and the third column gives the percentage of each group as compared with the total number of species of gamopetalous phanerogams found by us in the Park.

TABLE 6

ORIGIN OF THE PLANTS OF KRISHNAGIRI NATIONAL PARK

| Plants of | Number | Percentage |
|---|---|---|
| Bombay State ... ... ... | 4 | 2·13 |
| Bombay and South India ... ... | 15 | 8·55 |
| Bombay and other parts of India ... | 48 | 25·66 |
| West Asia and North Africa ... ... | 19 | 10·16 |
| East Asia and Malaya ... ... | 47 | 25·13 |
| Tropics ... ... ... ... | 54 | 28·87 |

C.E.C. Fischer in the Flora of Madras, following Hooker f., lists the 10 most abundant families for Madras. We have drawn a similar list for the families of gamopetalous angiosperms, and our results are the following :

TABLE 7

| Order | Family | No. of spp. in Kr. Nat. Park | Hooker's Order | Fischer's Order |
|---|---|---|---|---|
| 1 | Compositae ... | 36 | 7 | 7 |
| 2 | Acanthaceae ... | 27 | 6 | 4 |
| 3 | Convolvulaceae ... | 22 | ... | ... |
| 4 | Rubiaceae ... | 20 | 4 | 3 |
| 5 | Scrophulariaceae ... | 13 | ... | ... |
| 6 | Solanaceae ... | 9 | ... | ... |
| 7 | Labiatae ... | 8 | 9 | 9 |
| 8 | Verbenaceae ... | 6 | ... | ... |
| 9 | Asclepiadaceae ... | 6 | ... | ... |
| 10 | Apocynaceae ... | 6 | ... | ... |
| 11 | Bignoniaceae ... | 6 | ... | ... |

## OUR METHOD OF EXPLORATION AND RESULTS

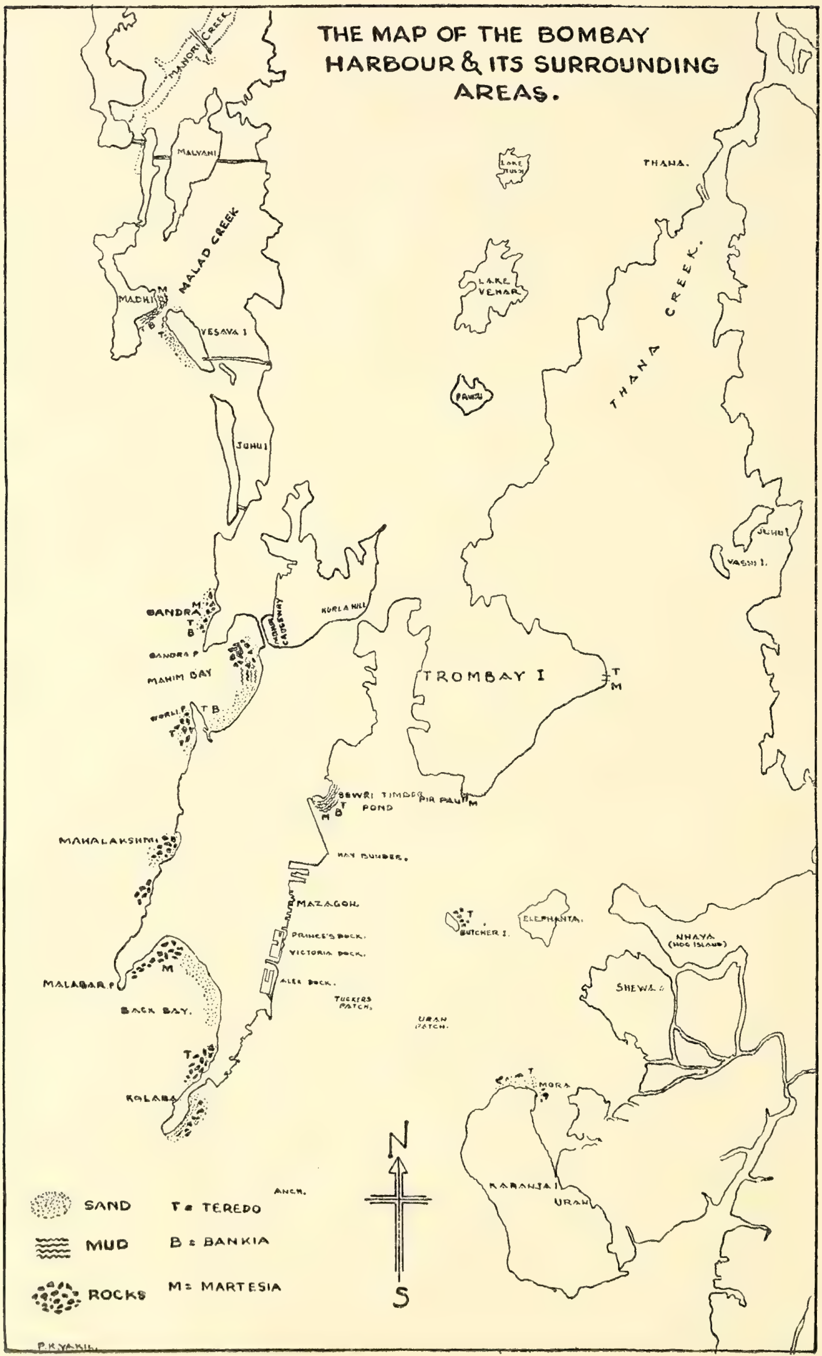
Our work has been rather intense, in the sense that the Park was visited at least once every week for three years. During the monsoon more frequent visits were paid, so as not to miss anything of interest in the flora of the Park. The whole area was divided into five or six small portions or areas; each one of these smaller areas was inspected at least once every month, so that roughly the whole Park was studied every month, and the various changes in the vegetation carefully noted in our field books.

After collection of the plants, these were taken to the laboratory and dissected carefully before mounting on herbarium sheets; the plants were at once sketched from the living specimen, and a large number of accurate drawings made of the individual plants and their important parts. Such drawings will form an integral part of the complete flora of the Krishnagiri National Park.

Although our work was mainly of a taxonomic nature, we paid great attention to the various associations of the plants of the Park, to their phenology etc. For our descriptions of the various plants we relied mainly on fresh specimens, though we did make use of the many specimens in Blatter Herbarium, Bombay. The data thus collected are all first-hand, and in many respects differ from the details found in published books on the subject.

Our results have been most encouraging; we have noted a number of new records, plants that had never previously been recorded for Bombay; a very large number of data have been recorded by us that in many respects differ from the published accounts of the plants under consideration; in all such cases of discrepancy we have made it a point to study the plant in the field again and again until we were quite satisfied that our observations were correct according to the actual facts seen in nature. We have added a few new plants to the flora of India.

It is our hope that in the near future the other parts of the flora of the Krishnagiri National Park will be worked out by other workers and that in time we shall be able to publish a complete illustrated flora of the Park.


THE MAP OF THE BOMBAY HARBOUR & ITS SURROUNDING AREAS.
MANORI CREEK
MALVANI
MALAD CREEK
MADH I
M
T B
T
VESAVA I
JUHU I
LAKE TULSI
LAKE VEHAR
PAWAI
THANA.
THANA CREEK.
JUHU I
VASHI I.
BANDRA
M
T
B
BANDRA P
MAHIM BAY
MAHIM CAUSEWAY
KURLA HILL
TROMBAY I
T
M
WORLI P
T B
SEWRI TIMBER POND
M B T
PIR PAU
M
MAHALAKSHMI
HAY BUNDER.
MAZAGON.
PRINCE'S DOCK.
VICTORIA DOCK.
ALEX DOCK.
TUCKERS PATCH.
URAN PATCH.
T
BUTCHER I.
ELEPHANTA.
NHAVA (HOG ISLAND)
SHEWA
T
MORA
MALABAR P
M
BACK BAY.
T
KOLABA
KARANJA I
URAN
ANCH.
N
S
SAND
MUD
ROCKS
T = TEREDO
B = BANKIA
M = MARTESIA
P. K. VAKIL
R.P.S

# MARINE ORGANISMS INJURIOUS TO SUBMERGED TIMBER IN THE BOMBAY HARBOUR

BY

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*(With one plate,* 12 *figures, and a map)*

Since ancient times, timber has been highly prized in marine constructions, particularly for ship-building, piles, fenders, bridges, ladders etc. At the same time the colossal economic loss caused on account of deterioration of timber structures through the action of marine organisms is well known. Nevertheless, treated timber is now recognised as being more suitable for certain purposes than metal or concrete by reason of its high resistance to corrosion, its elasticity, light weight, and comparatively low cost, coupled with high salvage value. In the United States, the United Kingdom and many other parts of the world, preservation of timber by impregnation with preservative chemicals under pressure has been practised to overcome the damage caused by marine wood borers, and of late the problem has been receiving some attention in India also. An investigation on ' The Protection of Timber against the attack of Marine Organisms ' has been recently undertaken at the Institute of Science, Bombay, under the auspices of the Wood Preservation Branch, Forest Research Institute, Dehra Dun. The present account deals with the observations made on the marine organisms and their destructive activity on timber in the Bombay Harbour and other places in the neighbourhood.

## THE MARINE WOOD BORERS.

The marine wood borers in general belong to two main groups-namely, the Mollusca and the Crustacea. The molluscan borers are represented by two distinct families of the class Lamellibranchiata, viz., (i) Teredinidae and (ii) Pholadidae. The former represents the entire group of ' Shipworms '—*Teredo* spp. and *Bankia* spp.—while the latter includes the ' Piddocks '—*Martesia* spp. and the *Xylophaga* sp. Amongst the crustacean borers some members of the family Sphaeromidae, of the subclass Isopoda, are well known for their destruction to timber. These are mainly *Sphaeroma vastator* and *Limnoria lignorum*, popularly known as the Gribble.

A survey of the marine borers from Bombay, carried out during 1953-54 revealed four species of *Teredo*, three of *Bankia* and two of *Martesia*. The most common among them are *T. reynei*, *Bankia setacea* and *Martesia striata*. The other three species of *Teredo* occasionally recorded are *T. navalis*, *T. austini* and *T. pertingens*. *B. debenhami* and *B. brevis* are also obtained. The crustacean borers are found to be practically absent.

## THE SHIPWORMS. (Figs. 1 and 10)

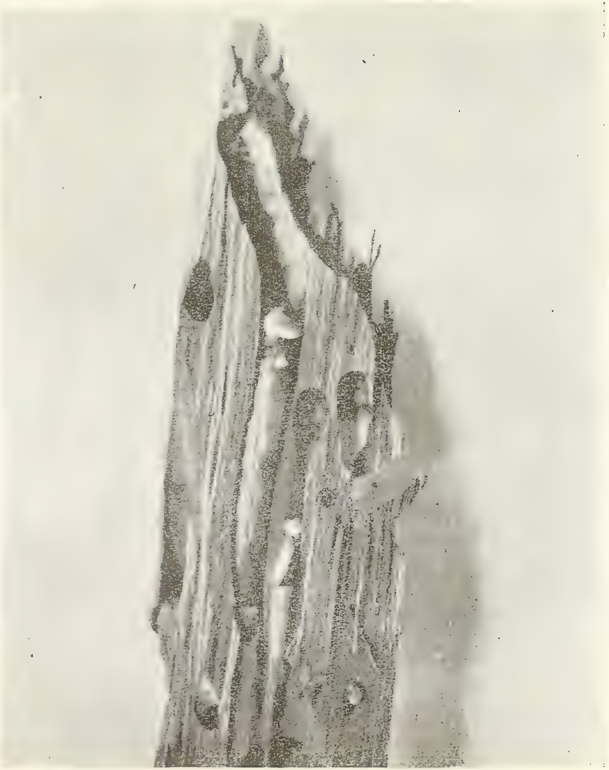
These wormlike Lamellibranchs (figs. 1, 6) have long delicate body, provided with specialized mechanisms for boring, respiration and protection, to suit the unique type of life they lead in timber. The boring apparatus consists of a pair of shell valves (figs. 2, 3, 7 and 8) surrounding the head region. The anterior and middle regions of each shell are covered with sharp, pointed, parallel ridges of teeth, which serve in scraping the wood surface, by the backward and forward movement of the valves. At the hindmost extremity of the body, there is a pair of delicate contractile tubes, the siphons (figs. 4 and 9) which project through the minute opening of the burrow. The ventral or incurrent siphon (SPH. IN) serves in intake of fresh water current for respiration, while the excreta and fragments of wood taken in during the boring process are discharged through the dorsal or the excurrent siphon (SPH. EX). The animal is afforded maximum protection by having a minute opening for its comparatively large burrow and a pair of hard calcareous structures, the pallets (figs. 4 and 9, PL), closing the opening against any external injury. The forward and backward movement of the pallets is brought about by muscular attachments in the collar region (CL). The two genera, namely *Teredo* and *Bankia* can be distinguished at a glance by the structure of the pallets. They are paddle or spoon-shaped in *Teredo* and plume-shaped with cone-in-cone elements in *Bankia* (figs. 5 and 10). The pallets serve as an important character in distinguishing the species of *Teredo* and *Bankia*, considering the great variety in their shape and structure.

It is interesting to note, that the shipworms have free-swimming larval forms, which move about for some time in search of a timber material. Soon after they settle on timber, the bivalve shell is developed. With the help of this, they start scraping timber, and grow with the size of the burrow into the worm-like adults. It is noteworthy that the burrows generally run parallel to the grain of timber. The burrow is the home of the individual, and once the shipworm is encased in it, it can never leave it, as the opening of the burrow is as small as a pin's head. After attaining a certain growth, these borers line their burrows with a film of pearly nacre, secreted by the mantle, and thus form hard calcareous tubes, which afford additional protection to the delicate body of the individual.

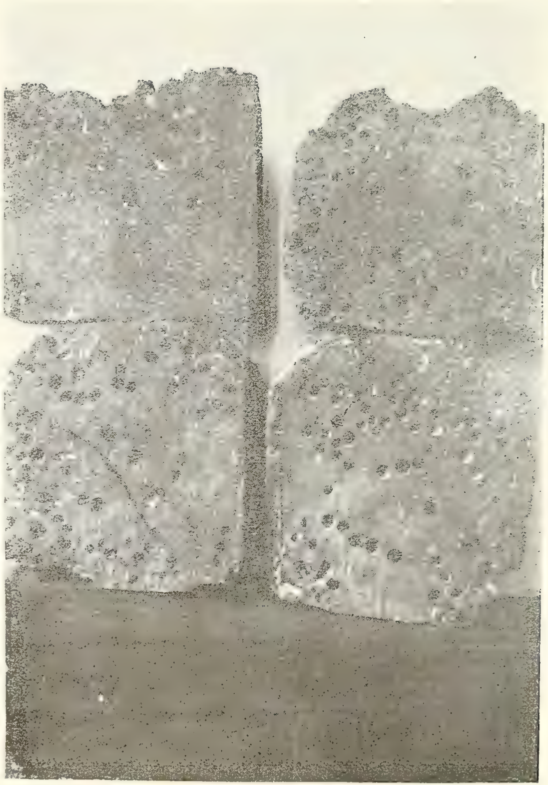
## THE PIDDOCKS. (Figs. 11 and 12)

The Piddocks of the genus *Martesia* are much similar to small mussels, and are pearshaped in appearance. They are highly destructive to timber making pearshaped pockets running across the grain of the timber. The body of each individual is enclosed in a bivalve shell and is provided with paired tubular siphons, serving the same purpose as in shipworms. Similarly, they are capable of infecting timber only while minute larval forms, which gradually excavate burrows in timber with the help of their shells to accommodate the growing body.

Very little is known about the existence of the chief groups of marine wood borers and their distribution in the Bombay Harbour. A coastal survey of the Harbour was therefore undertaken with the object of inspecting the remnants of some old wooden structures, fenders, ladders and such other timber material, deteriorating by the action of marine



Sample of timber with *Teredo* specimens in their burrows, exposed.



Cross-sections of fenders destroyed by *Teredo* at Trombay.

PLATE 1 TEREDO

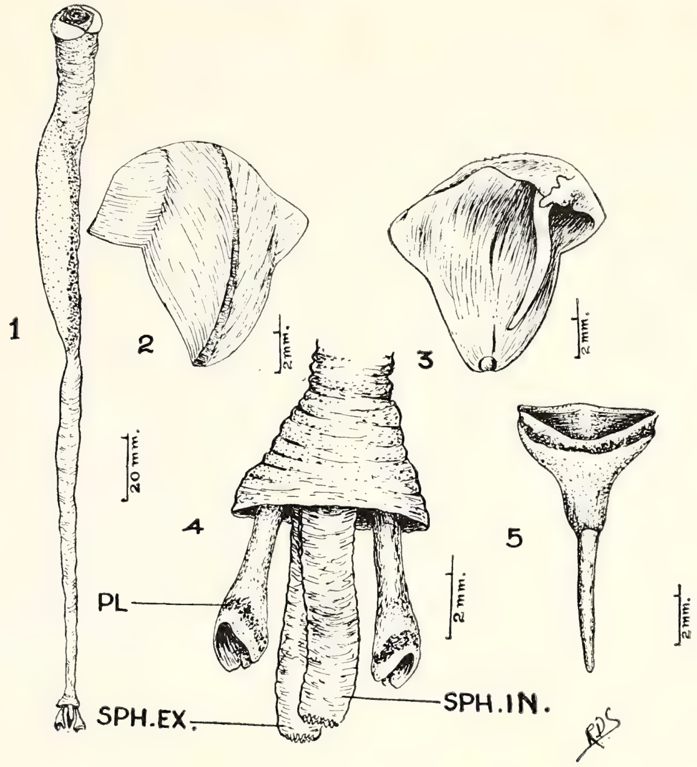
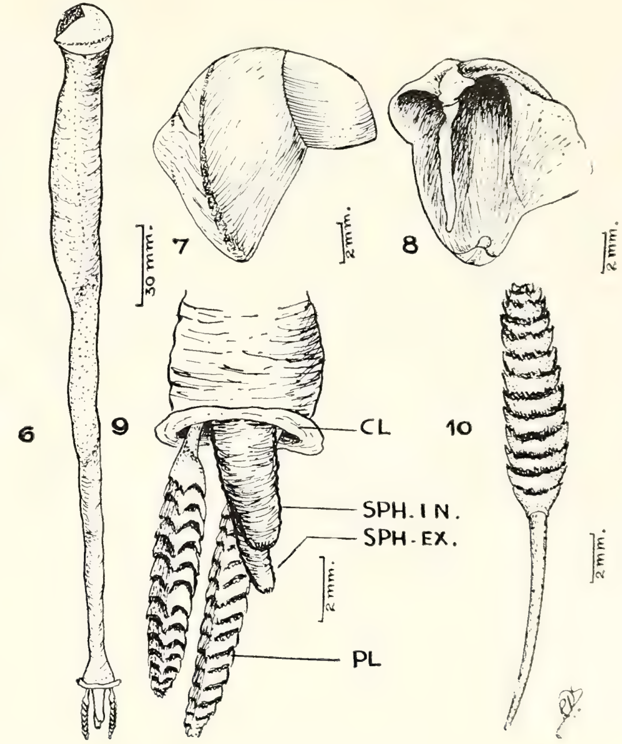
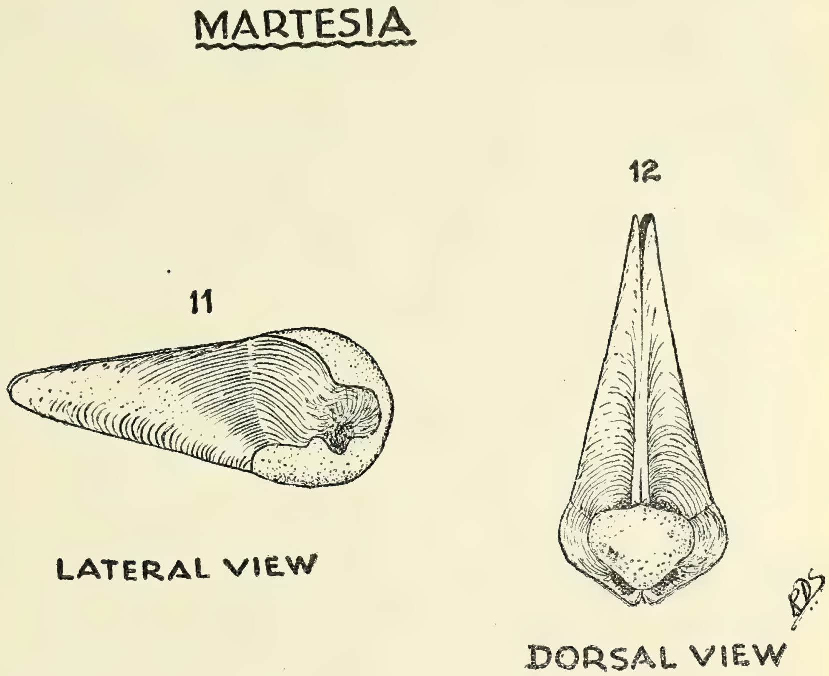

1
20 mm.
2
2 mm.
3
2 mm.
4
2 mm.
PL
SPH.EX.
SPH.IN.
5
2 mm.
RDS

PLATE 2 BANKIA


6
30 mm.
7
2 mm.
8
2 mm.
9
CL
SPH.IN.
SPH.EX.
2 mm.
PL
10
2 mm.

borers (see map). Some of the observations made during the year 1953–54 are given below.



Figs. 11 and 12.

Considering the damage done by the borers to many of the timber beams left on the mud flats at Sewri, this locality appears to be favourable for the growth and dispersal of the shipworms as they are predominant in this area. Specimens of *Teredo*, ranging from 5–350 mm. and of *Bankia* from 5–410 mm. in length have been so far noted from this locality (plate). It is interesting to note that a number of timber beams, as large as 50 to 60 cu. ft. each, have been completely destroyed by these borers. At Trombay, some discarded wooden fenders revealed the severe damage by *Teredo* (photo). Other localities where the shipworms, particularly *Teredo*, were found to occur are Butcher Island, Uran, Worli shore, Bandra shore, Versova and Madh Island.

The Piddocks (*Martesia* sp.) were also found to occur in certain localities in the Harbour waters. A timber log of the size of about a railway sleeper beneath the Pir Pau Jetty was heavily infested by these organisms. Some pieces of timber lying about and an old ladder along the jetty were also completely damaged by the activities of the same borer. The piles of an old wooden jetty at Madh Island were also infested by *Martesia* alone. Remnants of an old country craft on the mud flat at Madh Island, however, indicated the existence of all the three types, viz. *Teredo*, *Bankia* and *Martesia*, in this locality. A few forms of piddocks have been collected from some beams at Sewri Timber Pond along with the shipworms and also from a stray scantling on the Bandra shore. The deteriorated wooden fenders from the Naval jetty at Trombay were also found to be attacked by *Martesia* to some extent. It is of interest to note that *Martesia* has been also noticed to bore in certain soft rocks at Chaupati (Back Bay) and along the Bandra shore. The observations made during the survey seem to indicate that *Martesia* is commonly found along Pir Pau and Madh Island. The size of the *Martesia* specimens varied between 8 to 35 mm. in length.

It appears from the observations made so far that the marine wood borers are to some extent confined to certain localities in their distribution. The shipworms are vigorously active at Sewri Timber Pond, and piddocks at Pir Pau and Madh Island. They are generally found to occur on separate timber structures, though occasionally the three genera, namely *Martesia*, *Teredo*, and *Bankia*, are taken from the same.

Further work relating to the distribution and movements of the borers and the relative intensity of their attack on various species of Indian timbers is in progress at this Institute.

The above work has been carried out with funds provided by the Forest Research Institute, specially obtained from various sources for the execution of the scheme on the protection of Indian timbers against the attack of marine organisms.

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# THE 'SLUG' CATERPILLAR, *PARASA LEPIDA* CRAM., AND ITS CONTROL

BY

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AND

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(*With one plate*)

## Introduction

The slug caterpillars belong to the family Eucleidae (Limacodidæ) of the order Lepidoptera. Ayyar (1932) has recorded a few forms such as *Parasa lepida* Cram., *Contheyla rotunda* Hampson, *Natada nararia* Moore, *Thosea cervina* Moore, and *Belippa laleana* Moore, as occurring in South India on various plants. Of these *Parasa lepida* Cram., is the commonest and most important, and is usually known as the Castor Slug. The insect has appeared in pest form, twice in the College orchard, Coimbatore, during the past dozen years. The studies on the life cycle and general morphology of the larvæ were made by the senior author during 1934 when the pest appeared in a severe form, defoliating mango trees. At the second severe outbreak of the pest on mango and citrus, in the year 1953, the observations were continued and some trials were conducted with success on the control of the pest by use of synthetic chemicals. A brief account of the pest together with observations on the control aspects are recorded hereunder.

## The Insect and its Distribution

The adult insect is a short stout moth (fig. 1) with forewings predominently green in the middle and brownish at either end. According to Ayyar (1940), Burns *et al.* (1921), Corbett (1932), and Venkatasubban (1950), the insect is widely distributed in South India, Bombay and Bengal, as well as in Malaya and Ceylon, outside India.

## Nature and Extent of Damage

The caterpillar is known to infest a variety of plants. Citrus and mango plants were found severely damaged and castor to a lesser extent during 1953, as observed by the authors. The young caterpillars feed gregariously on the lower surface of the tender leaves scraping the green matter and causing the eventual drying up of the foliage. As the caterpillars grow in size, they scatter themselves and start feeding on the entire leaves. Young mango and citrus plants get defoliated completely. Badly affected castor plants bear only the skeletonized leaves, the entire leaf blade being reduced to the mid-rib and a few veins. Corbett (1932) and Venkatasubban (1950) have observed the pest causing serious damage to coconut palm by the larvæ eating the green matter of the leaflets, and ultimately leading to the drying up of the fronds. Besides the above plant, the insect has been recorded as infesting also Palmyra, Wood Apple, Pepper, Pomegranate, Cauliflower, Tea, Coffee, Banana, Rose, Country almond etc. (Barlow 1900, Fletcher 1914, and Lefroy 1909). The insect is thus a polyphagous one, subsisting on a variety of plants.

Apart from its role as a serious pest, the caterpillar is dreaded by man for the acute irritation and pain it causes at the slightest contact with human skin.

## LIFE HISTORY AND NATURE OF THE CATERPILLAR

Various authors have broadly indicated the general habits or life history of the insect. Corbett (1932) and Venkatasubban (1950) have furnished more details. The bionomics were studied at Coimbatore by the senior author in 1934. The moths in captivity did not lay eggs. As observed under field conditions, the moth is known to deposit flat shining eggs in batches of 20–30 on the underside of the leaves. The caterpillars hatch out in about 6–7 days and begin to feed on the green matter of the foliage near about the site of eggs, all remaining together. The caterpillars reared (figs. 2 and 3) become full grown, measuring about an inch in length with stout body, in about 6 weeks. The caterpillar has 4 rows of spiny scoli placed laterally and dorsally, (figs. 4 and 5). The ventral surface is flat and fleshy, and the larva moves slug-like. Coloration is white on the ventral surface and greenish above. The spines on the scoli (fig. 5) are numerous, tipped red or black, and they cause irritation and pain by glandular secretion. The full grown larva pupates in a thick shell-like cocoon, (fig. 6). The pupal cocoon is compact, elliptical, chocolate-brown in colour at first, later turning grey, and hard. The upper surface is convex and the lower surface flat, and each cocoon is provided with a circular lid to allow exit for the emerging moth. Sometimes thousands of these are found attached to the trunks and branches of attacked trees. The pupal period lasts for about 3 weeks. Even the cocoon is irritating to the touch. The life cycle is completed in about 10 weeks.

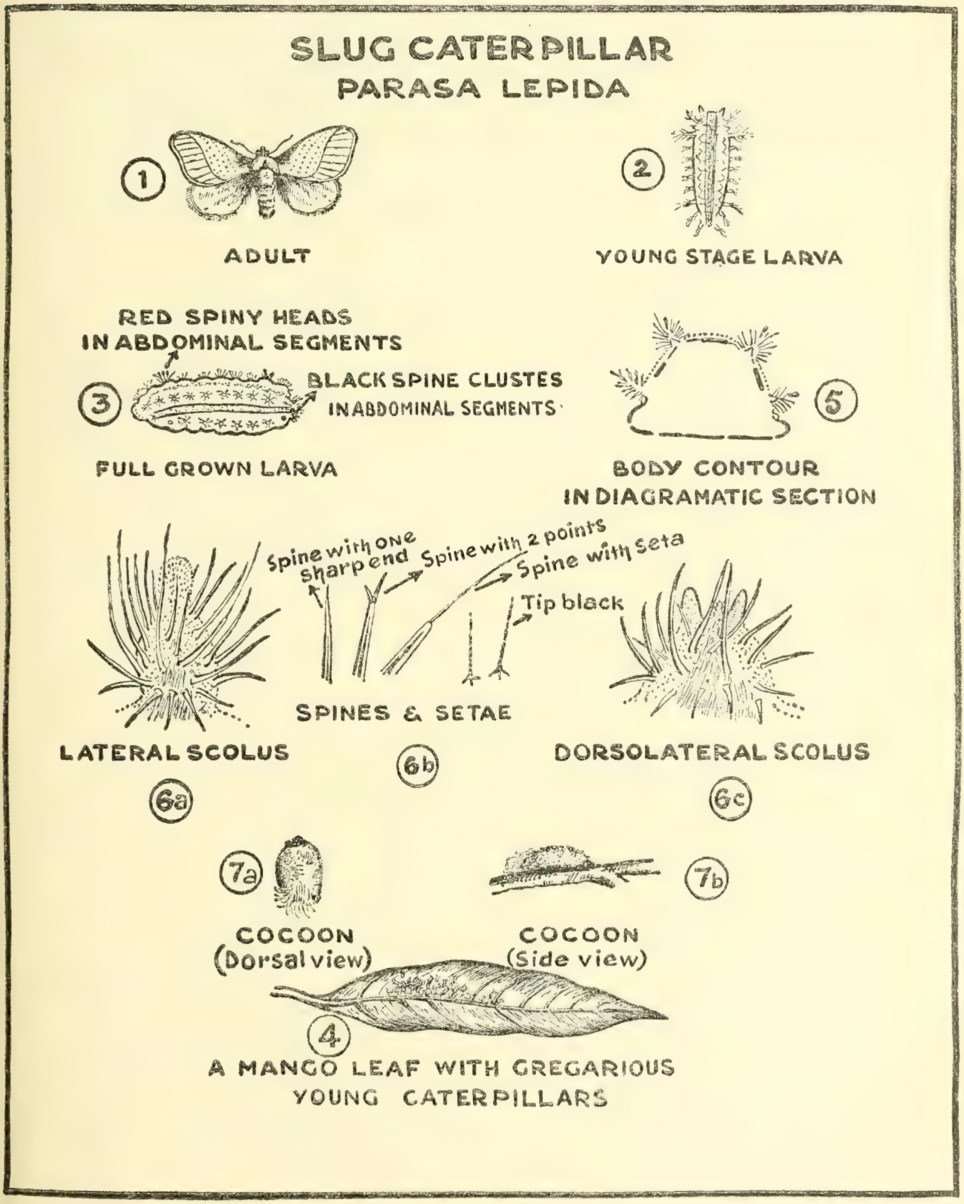
## PROBLEM OF CONTROL

### (i) Natural Enemies

Ayyar (1934 and 1940) and Thompson (1946) make mention of predators and parasites which are about a dozen. The following parasites and predators are recorded in South India at Coimbatore:

(1) *Apanteles* sp. }
(2) *Chinocentrus* sp. } Braconidae.
(3) *Stomatoceras ayyari* G. Chalcididæ.
(4) *Eurytona parasae* G. Eurytomidæ.
(5) *Phycita aientinella* H. Phycitidæ.

But none of these seem to exercise any appreciable check on the pest.


SLUG CATERPILLAR
PARASA LEPIDA
1
ADULT
2
YOUNG STAGE LARVA
RED SPINY HEADS
IN ABDOMINAL SEGMENTS
3
BLACK SPINE CLUSTES
IN ABDOMINAL SEGMENTS
FULL GROWN LARVA
5
BODY CONTOUR
IN DIAGRAMATIC SECTION
Spine with one sharp end
Spine with 2 points
Spine with seta
Tip black
SPINES & SETAE
LATERAL SCOLUS
6a
6b
DORSOLATERAL SCOLUS
6c
7a
COCOON
(Dorsal view)
7b
COCOON
(Side view)
4
A MANGO LEAF WITH GREGARIOUS
YOUNG CATERPILLARS

### (ii) Older Methods of Control

Fletcher (1914), Ayyar (1940) and others recommended hand picking of caterpillars, destruction of pupae and spraying of arsenates or other stomach poisons in bad cases. Mechanical destruction by hand picking will be effective if it is done in the early stages, when the larvæ are gregarious and many of them are crowded in individual leaves. But in tall trees infested by large numbers of caterpillars, hand picking becomes impracticable and especially so when the larvæ have scattered themselves. Hand picking has to be done with utmost care as the caterpillars are highly irritating to the touch.

Sprays of lead arsenate or calcium arsenate have seldom given satisfactory results.

### (iii) Trials with new Insecticides

On the occurrence of the pest in serious form on mango and citrus in and around the College orchard, Coimbatore, during September to November 1953, investigations on its control by means of the synthetic chemicals DDT and BHC, which are in large scale use for the control of various other pests, were undertaken. The data gathered from separate trials conducted on mango and citrus are furnished below.

#### (a) *Trials on Infested Mango trees*

Four heavily infested trees of medium size were selected for each treatment and the population of caterpillars on 25 random leaves per tree was counted before and after treatment.

TABLE I

*Parasa lepida*. Treatment and population counts

| Treatments | No. of leaves examined per treatment. | Population before treatment. | Population after treatment in | | | Percentage of reduction in population |
|---|---|---|---|---|---|---|
| | | | 24 hours | 48 hours | 72 hours | |
| 1. BHC 0·05% spray | 100 | 307 | 38 | ... | ... | 100 in 48 hrs. |
| 2. DDT 0·16% spray | 100 | 282 | 148 | 82 | 54 | 80.8 in 72 hrs. |
| 3. Control | 100 | 258 | 269 | 244 | 278 | Nil. |

#### (b) *Trials on Citrus plants.*

Trials were conducted on similar lines on malta lemon on which also the pest appeared in severe form. The following results were obtained.

TABLE II

*Parasa lepida.* Population counts on citrus trees

| Treatments | No. of leaves examined per treatment | Population before treatment | Population after treatment in | | | Percentage of reduction in population |
|---|---|---|---|---|---|---|
| | | | 24 hours | 48 hours | 72 hours | |
| 1. BHC 0·05% spray | 100 | 194 | 16 | ... | ... | 100 in 48 hrs. |
| 2. DDT 0·16% spray | 100 | 210 | 184 | 100 | 29 | 86·2 in 72 hrs. |
| 3. Control | 100 | 178 | 189 | 168 | 172 | 3·4 in 72 hrs. |

From the above trials it is seen that BHC 0.05% can effect a complete mortality of the caterpillars within 48 hours after treatment. In half an hour after spraying, a number of caterpillars were noted falling down paralysed, from the trees. DDT showed delayed action, and it did not give as thorough a control of the pest as BHC used.

In the trials conducted, spraying was adopted in preference to dusting as the former alone was found practicable for dealing with the caterpillars which usually remain on the underside of the leaves. The advantage of spraying is much more felt when tall and densely grown trees have to be treated.

Cost of treating with BHC 0·05% (Gamma isomer)

Quantity of spray fluid per mango tree of medium size 4 gallons.

| | | Rs. | A. | P. |
|---|---|---|---|---|
| Cost of chemical for treating one tree | ... | 0 | 4 | 6 |
| Labour charges (approximate) | ... | 0 | 1 | 6 |
| Total | ... | 0 | 6 | 0 |

For preparing 0·05% BHC, 1 lb. of the 50% wettable powder is mixed in 13 gallons of water. The cost may vary according to the size of the tree and the volume of spray fluid used. The cost of treatment is invariably less for citrus plants.

## SUMMARY AND CONCLUSION

*Parasa lepida* Cram. is a serious pest of sporadic occurrence on mango, citrus, castor, coconut and other plants. Its life cycle occupies about 10 weeks. The caterpillar has tubercles and spines on its body, which are poisonous and irritating to the touch. During heavy outbreaks the insect defoliates the plants completely. Handpicking and mechanical destruction are practicable in early stages when the larvae are gregarious, and affected individual leaves can be clipped. Of the two chemicals, DDT and BHC, tried against the pest, BHC 0·05% (gamma) spray proved very efficient. The cost of treating a medium sized tree may come to about six annas (Re 0–6–0) only.

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# NEW PLANT RECORDS FOR BOMBAY--III

BY

H. SANTAPAU, S.J., F.N.I.

AND

C. SALDANHA, S.J., B.SC. (Hons.)

(*With five plates*)

This is a continuation of the series by the senior author, the last number of which appeared in this *Journal* (52 : 661–663, 1955). Intensive search of the flora of Bombay by the authors has produced a number of new records, which so far have not been mentioned for the State of Bombay in any of our provincial or national Floras. The illustrations are all by the junior author, who for some time has been working on the Systematics of the Personales of Bombay. Some of our plants have been found by us in the field; others have been identified by us in Blatter Herbarium, St. Xavier's College, Bombay.

1. **Lindernia pyxidaria** Allioni in Misc. Taurin. 3 : 178, t. 5, 1766; Linn. Mant. 2 : 252, 1771; Haines, Bot. Bih. and Or. 634; Pennell, Scroph. W. Himal. 28; Mukerjee in *Journ. Ind. Bot. Soc.* 24 : 131, 1945 (Plate I). Scrophulariac.

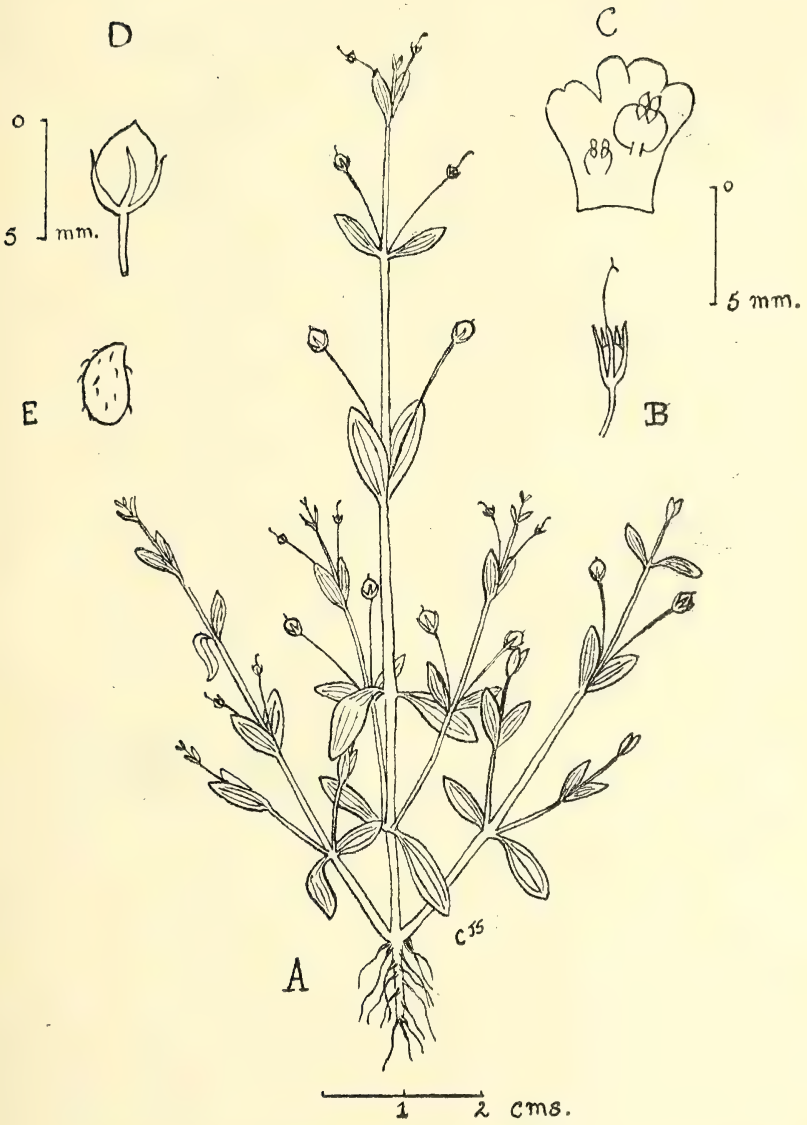
*Gratiola integrifolia* Roxb. Fl. Ind. 1 : 138, 1820.
*Vandellia erecta* Benth. Scroph. Ind. 36, 1834; Fl. Brit. Ind. 4 : 281.
*Vandellia pyxidaria* Maxim.: Prain, Beng. Pl. 769; Gamble, Fl. Madr. 960.

We have followed Hooker, Haines, Pennell etc. in considering the Indian plant as identical with the European one; further we have taken *Gratiola integrifolia* Roxb. to be the same as our plant although Roxb. includes his plant under Diandria and not under Didynamia.

The present species is supposed to be widespread all over India; so far, however, it has only been found in Khandala by Santapau in 1953; it is therefore extremely rare in Bombay State, but further careful search will probably give more complete data about its distribution in Bombay.

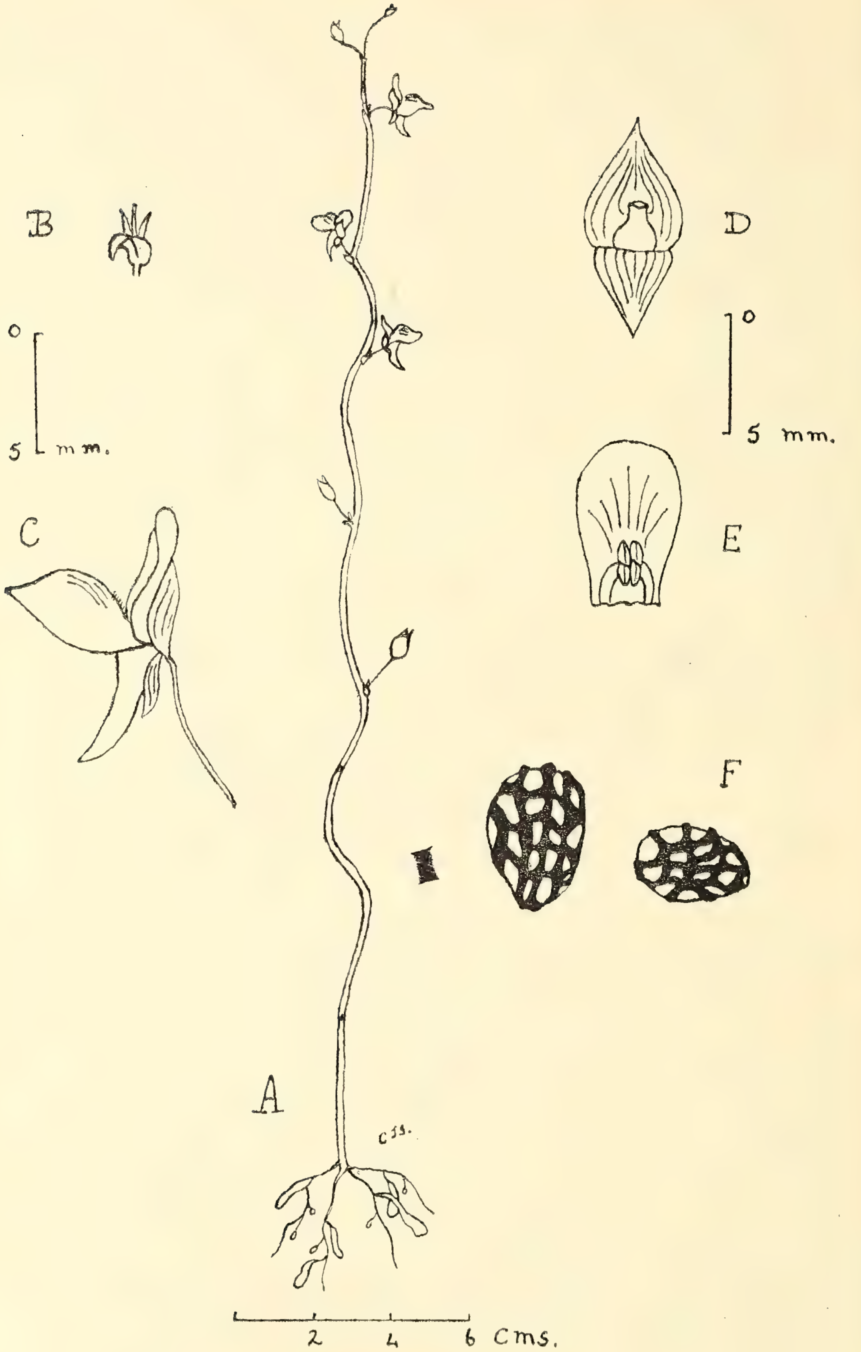
Description: Annual, slender, glabrous herbs. *Stems* divaricately branched from the base, rooting at some of the lower nodes. Leaves opposite, decussate, sessile, elliptic, entire or shallowly and obscurely crenate, up to 1·5 × 0·7 cms.; nerves 3–5, parallel.

Flowers solitary, axillary; pedicels slender, longer than the leaves or sepals, exceeding 1·5 cms. long; calyx 5-lobed, divided almost to the base; lobes linear or lanceolate, 2 mm. long in flower, elongating to 3 mm. in fruit; corolla 2-lipped, 5 mm. long; stamens 4, fertile, didynamous; anterior filaments larger, arched, appendiculate, pubescent at the base; the posterior ones shorter, inserted at lower level; anther-cells entire, connivent at the apex; ovary ovoid, glabrous; style filiform, 2 mm. long;


D
0
5
mm.
E
C
0
5 mm.
B
A
C 55
1
2 cms.

*Lindernia pyxidaria* All.

A. Entire plant ; B. Calyx with ovary, style and stigma ; C. Corolla with stamens ; D. Capsule ; E. Seed, highly magnified.


B
0
5 mm.
C
D
0
5 mm.
E
F
A
2 4 6 Cms.

*Utricularia smithiana* Wight

A. Entire plant ; B. Bracts and bracteoles ; C. Flower ; D. Calyx with ovary, style and stigma ; E. Upper lip with stamens ; F. Seeds highly magnified.

stigma forked. Capsule subglobose to ovoid, slightly exceeding the calyx ; seeds oblong, sparingly covered with hyaline hairs.

This plant was collected in Khandala by the senior author in May 1953 (*Santapau* 12749–12750 of 3 May and 12781–12784 of 23 May), growing in moist ground near the railway line. It was quite abundant locally ; the colour of the corolla was noted at the time of collection as bluish or whitish.

2. **Utricularia smithiana** Wight, Icon. t. 1577, 1850 ; Gamble, Fl. Madr. 982, 1924 (Plate II). Lentibulariac.

*U. caerulea* Linn. var. *smithiana* Clarke in Hook. f. Fl. Brit. Ind. 4 : 331, 1884.

Slender annual, insectivorous herb. *Rhizome* filiform, bearing bladders. *Leaves* linear-spathulate, 7 mm. long. *Scapes* erect or twining, up to 30 cms. long; scales few, ovate, pointed, 1 mm. long. *Flowers* pedicellate ; bract broad, ovate, acute, 1–1·5 mm. long; bracteoles 2, narrower, lanceolate, equal to the bract in length; pedicels slender, filiform, 7 mm. long in flower, 1·5 cms. long in fruit; calyx-lobes 2, slightly unequal, posterior one broader, ovate, 4 mm. long; the lower one narrower, 3·5–4 mm. long, shorter than the pedicel, slightly decurrent in fruit; corolla 2–lipped, ' blue shaded mauve lilac ' (Gamble); upper lip obovate, longer than the calyx lobe, 6 mm. long; lower lip broadly orbicular, pubescent near the throat, 7 mm. long in the North Kanara specimens ; spur conical, curved outwards, about as long as the lower lip and larger than the calyx lobes. Stamens 2, on the upper lip ; filaments broad ; anthers 2-celled, connivent ; ovary lenticular ; style short. Capsule lenticular, enclosed by the enlarged calyx lobes, 2–3 mm. long ; seeds subglobose, scrobiculate.

*Sedgwick* 4469, collected in Oct. 1918 at Devarayi, near Londa in North Kanara.

The flowers in *Sedgwick* 4469 are decidedly smaller than those shown in Wight's Icon No. 1577 ; the seeds in Wight's picture are more reticulate than scrobiculate. It was probably this that led Clarke to reduce this species to varietal rank ; a careful examination of the seeds has shown to us that the reticulate ridges do surround scrobiculations.

3. **Chirita hamosa** R. Br. var. **unifolia** Clarke in Hook. f. Fl. Brit. Ind. 4 : 361, 1884 (Plate III). Gesneriaceae.

There has been a good deal of discussion regarding the validity of the genus *Chirita* Buch.-Ham. as distinct from *Didymocarpus* Wall. The latter was said to possess an *entire* stigma and the former a *bilobed* one. The variations that appear with advancing age of the flower and the ambiguity of the terms have created much difficulty. Clarke acknowledged the distinctions between the two genera as unsatisfactory, but refrained from fusing them into one. Otto Kuntze in 1891 fused the two genera into one, under the name of *Roettlera* Vahl. The problem has been reconsidered by B. L. Burtt, who advocates the retention of the two separate genera. He has redefined the ' entire ' stigma of a species of *Didymocarpus* sect. *Eudidymocarpus* as a robust capitate structure, whilst the ' bilobed ' stigma of a typical *Chirita* is oblique, bifid and thin ; the emphasis seems to be on the oblique and slender nature of the stigma rather than on its bilobed appearance. We have followed Burtt in keeping the two genera separate. (Burtt in *Notes R. Bot. Gard. Edinburgh* 21: 185–209, 1954).

The variety *unifolia* described here is quite unlike the typical *Chirita hamosa* in that it possesses a single leaf; the floral structure is the same in both plants.

Annual herbs. *Stems* slender, erect or curved, glabrous or sparingly pilose, 3–6 cm. long. *Leaf* solitary, shortly petioled, ovate, entire or slightly crenate, weakly hairy on both surfaces, penninerved, 6×4 to 15×8 cms.; secondary nerves 10–16 pairs. *Inflorescence* of about 6 flowers in the leaf axil; pedicels all connate at the base for about 1 mm., then fused in pairs for about 3 mm.; their free portions 1 cm. long, hispidulous; calyx 7–8 mm. long, tubular, hispidulous; lobes 5, linear-lanceolate, free for about half their length, persistent; corolla 1·5 cms. long, 2-lipped; tube slender; mouth 'pale blue or rosy' (Clarke); stamens 2 or rarely 3 fertile, epipetalous; anther cells entire, oblique, connate at the apex; staminodes usually 2, filiform; ovary hispid, 3 mm. long; style slender, 7 mm. long, hispid; stigma bifid. *Capsule* glabrous, except at the tip near the persistent style, straight or highly curved; seeds many, small, ellipsoid.

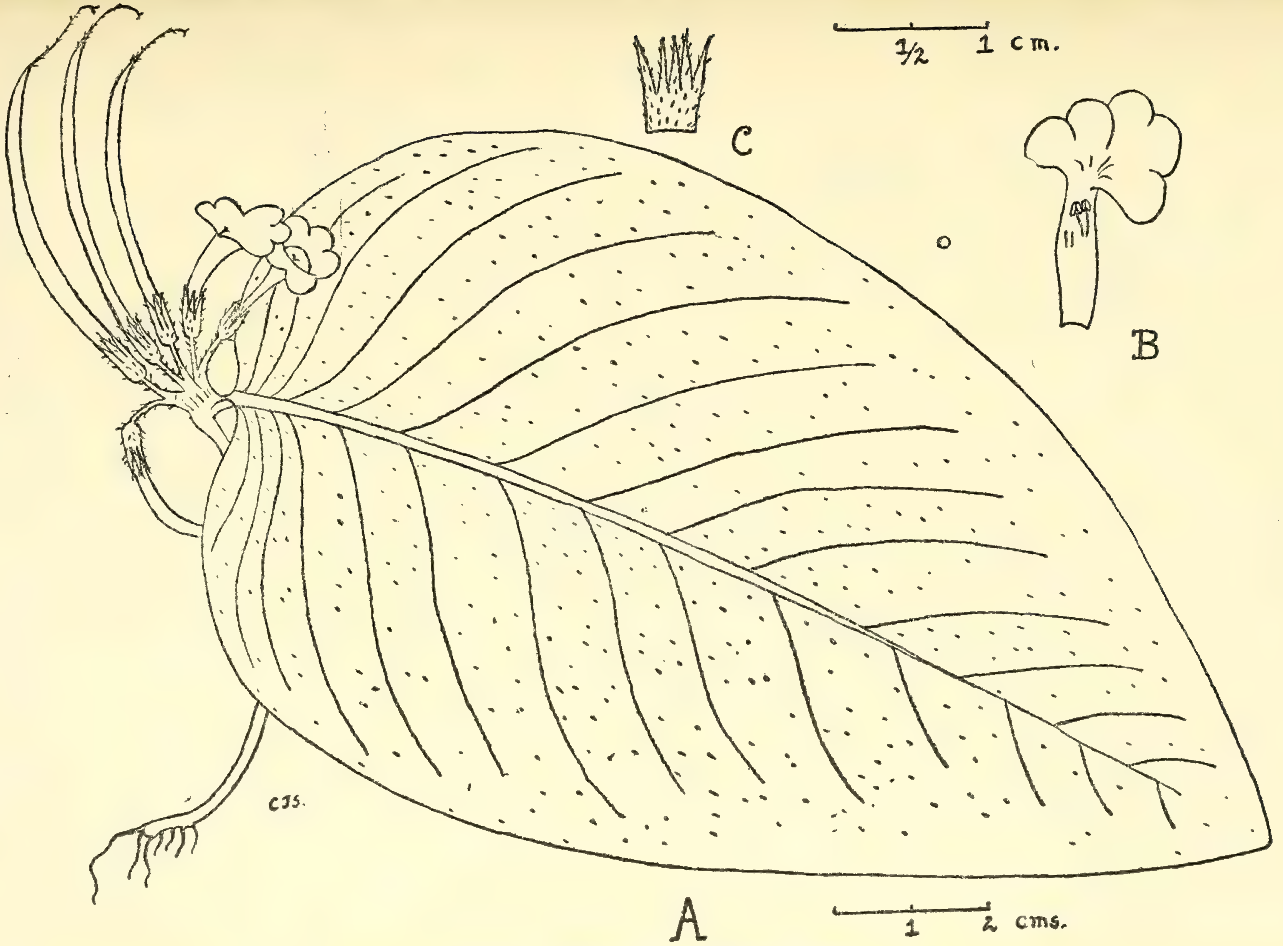
*T. R. D. Bell* 3171 in Herb. Sedgwick, collected in North Kanara in 1917. The specimen is preserved in Blatter Herbarium, but bears no further indication of the exact locality where the plant was collected.

4. **Didymocarpus pygmaea** Clarke in DC. Mon. Phan. 5(1): 82, 1883, et in Hook. f. Fl. Brit. Ind. 4: 345, 1884; Haines, Bot. Bih. and Or. 648; Gamble, Fl. Madr. 988; Burtt in *Notes R. Bot. Gardn. Edinb.* 21: 202, 1954 (Plate IV). Gesneriac.

*Roettlera pygmaea* O. K. Rev. Gen. Pl. 2: 476, 1891.

The name *Didymocarpus* Wall. 1819, is *nom. cons.* against *Roettlera* Vahl, 1805, and is listed in the Intern. Code of Bot. Nomencl. under No. 7810.

Annual pubescent herbs. *Stems* slender, curved or straight 3–7 cms. high. *Leaves* usually solitary, rarely two or more smaller ones are borne on a prolongation of the stem, sessile, ovate to ovate-oblong, penninerved, membranaceous, glistening and hairy on the upper side, hairy along the nerves on the lower side, 3–9 cms. long; apex obtuse; base shallowly cordate; secondary nerves 6–9, prominently arched. *Flowers* 4 or more, fascicled, arising from the base of the leaf; bracts usually small, near the outermost pedicel, sometimes larger and leaf-like, up to 4 cms. long; pedicels free, 1–3 mm. long in flower, up to 5 mm. in fruit, hairy; calyx tubular, hairy, 5-lobed, divided almost to the base, 3 mm. long in flower, up to 5 mm. long in fruit; sepals linear-lanceolate, 3 mm. long, somewhat enlarged in fruit; corolla tubular, white, 4 mm. long, pubescent externally in the limb, unopened in our specimens from Pavagadh. Stamens 2 fertile; anther cells oval, oblique, confluent at the top; filaments in the unopened flowers flexed near the base; staminodes 2, inserted a little lower than the stamens, filiform, 1 mm. long; ovary oblong, hairy, 1 mm. long; style reflexed in the unopened flowers, 3 mm. long, hairy; stigma funnel-shaped, not oblique. *Capsules* straight elongated, cylindrical, hispid, surmounted by the remnants of the style, 2-valved, 1·5–2 cms. long; seeds ellipsoid, punctate.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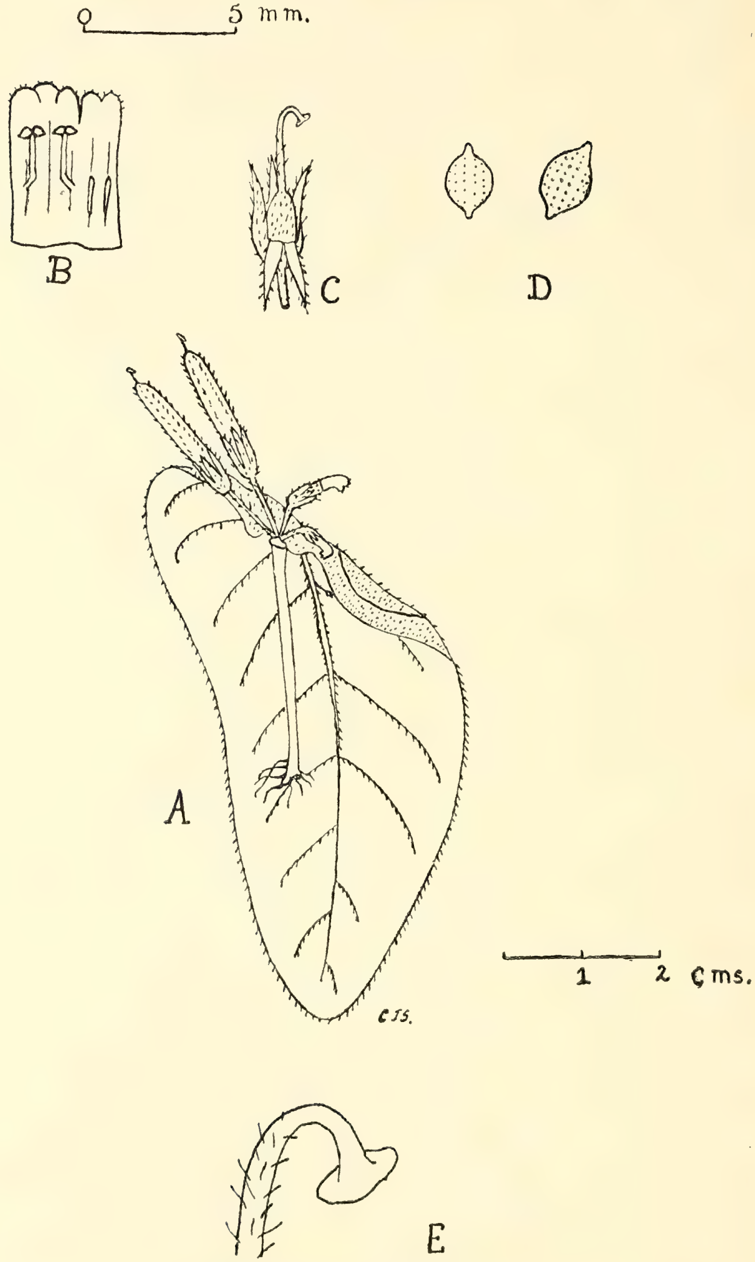
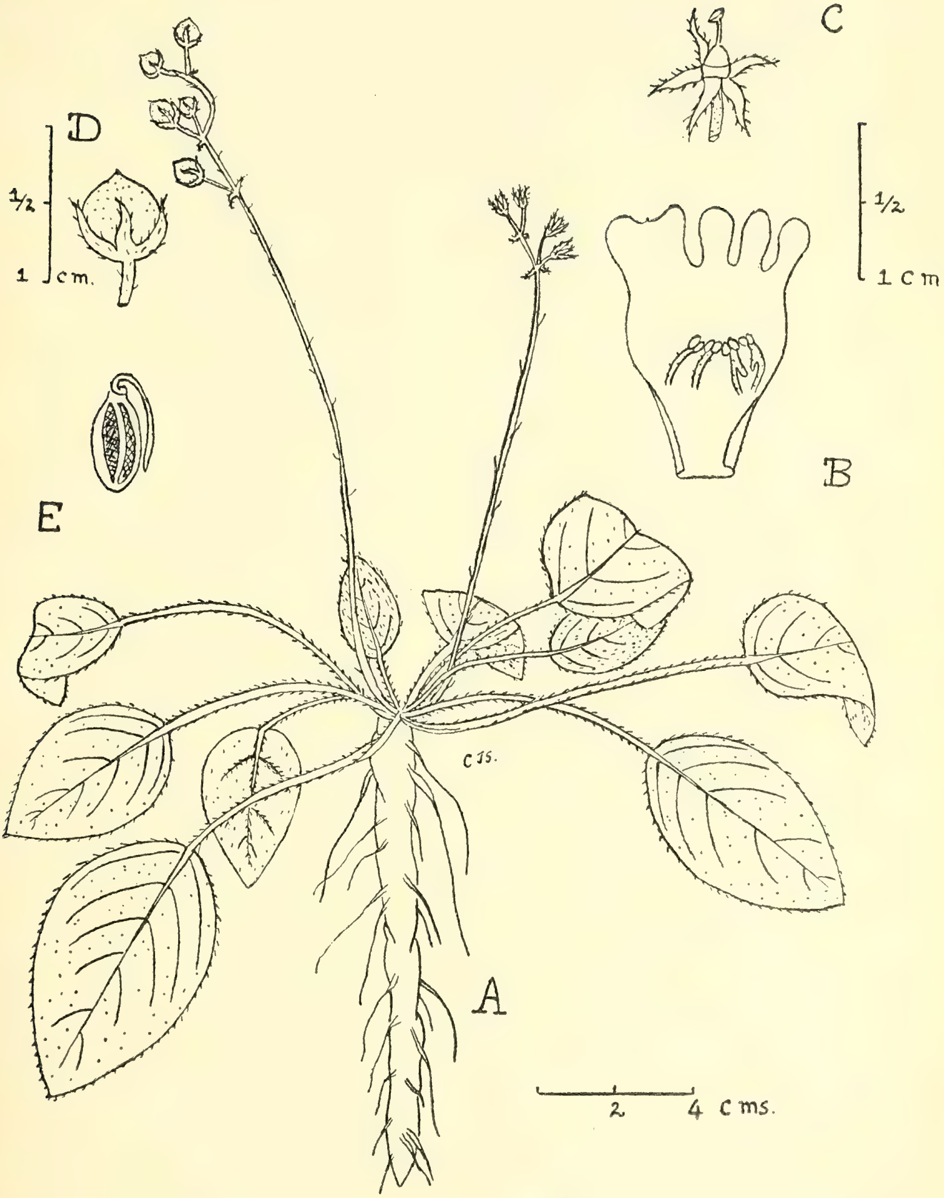
*Chirita hamosa* var. *unifolia* Clarke

A. Entire plant ; B. Corolla with stamens and staminodes ; C. Calyx



*Didymocarpus pygmaea* Clarke

A. Entire plant; B. Corolla with stamens and staminodes; C. Calyx with ovary, style and stigma; D. Seeds (highly magnified); E. Stigma (highly magnified).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*Jerdonia indica* Wight

A. Entire plant ; B. Corolla with stamens (Adapted from Wight) ; C. Calyx with disc, ovary, style and stigma (Adapted from Wight) ; D. Capsule ; E. Seed with funicle.

A peculiar floral structure was observed in two flowers of a specimen collected from Pavagadh on the 29th December 1954. One of the flowers had 6 epipetalous stamens with small dehisced anther cells. There were three ovaries. Of these one was completely free while the other two were slightly adnate at the base. The styles were entirely free. The stigmata, although basically of normal structure, were split in the middle so as to appear bilobed. The other flower of the same plant had 4 epipetalous stamens and 4 others slightly adnate to the two distinct ovaries. The plant bore 3 fruits which, though stunted, appeared to be of normal structure.

A careful search on two different occasions has yielded only cleistogamous flowers ; this confirms the observations of Haines ; but we have failed to find the bulbils mentioned by the same author.

*Saldanha* 1782–1786 of 13th October 1954, and *Saldanha* 2200 of 29th December 1954 ; collected from the fort walls at Pavagadh near Baroda.

5. **Jerdonia indica** Wight, Icon. t. 1352, 1850 ; Clarke in DC. Mon. Phan. 5 (1) : 164, 1883 & in Hook. f. Fl. Brit. Ind. 4 : 368, 1884 ; Gamble, Fl. Madr. 991, 1924 (Plate V). Gesneriac.

Perennial, acaulescent, scapigerous herbs. *Rootstock* thick, scarred, bearing numerous secondary roots, 6-25 cms. long. *Leaves* crowded at the base ; petioles long, grooved, rusty-villous, 4–13 cms. long ; leaf-blade elliptic to ovate, sparingly rusty-villous on the upper side especially when young, prominently rugose-pilose along the margins and along the nerves on the lower side, reticulately veined, 4 × 3 to 9 × 6 cms. ; secondary nerves about 8 pairs. Scapes few, slender, sparingly rugose-pilose ; bracts sublinear, rusty-villous, 2 mm. long ; pedicels hairy, often in pairs, 5 mm. long in flower, 7 mm. long in fruit ; calyx ± 5-partite, 5 mm. long ; lobes lanceolate, rusty-villous ; corolla 'pale lilac marked with red lines, (Gamble), 1·7 cms. long ; tube elongate, swollen upwards ; limb oblique, 2-lipped ; upper lip 2-lobed, emarginate ; lower lip 3-lobed ; stamens 4, all fertile ; anterior filaments dilated, spurred, sparingly hairy ; posterior pair also dilated and hairy but not spurred ; anthers 2-celled, cohering at their apices so as to cover the stigma ; disc-cup-shaped ; ovary ovoid, glabrous ; style linear, glabrous ; stigma peltate. Capsule ovoid, puberulous, loculicidal, 2-valved, 5 mm. in diameter ; seeds small, ellipsoid, laterally grooved, sub-umbonate at the apex ; funicle prominent and white.

Wight's figure shows a number of adventitious roots arising from the base of the stem. All the specimens in Blatter Herbarium, however, have a prominent rootstock giving rise to secondary roots. We have adapted the description of the corolla, stamens and ovary from Wight, since all our specimens are only in fruit.

*Hallberg and McCann* 34539, 34540, 34542 and *Sedgwick* 6786 from Sampkhand, North Kanara ; collected in Oct, 1919. *Sedgwick and Bell* 7224 from Malemane Ghat, North Kanara, October 1919.

# NEW PLANT RECORDS FOR BOMBAY—IV

BY

H. SANTAPAU, S.J.

*(With four plates)*

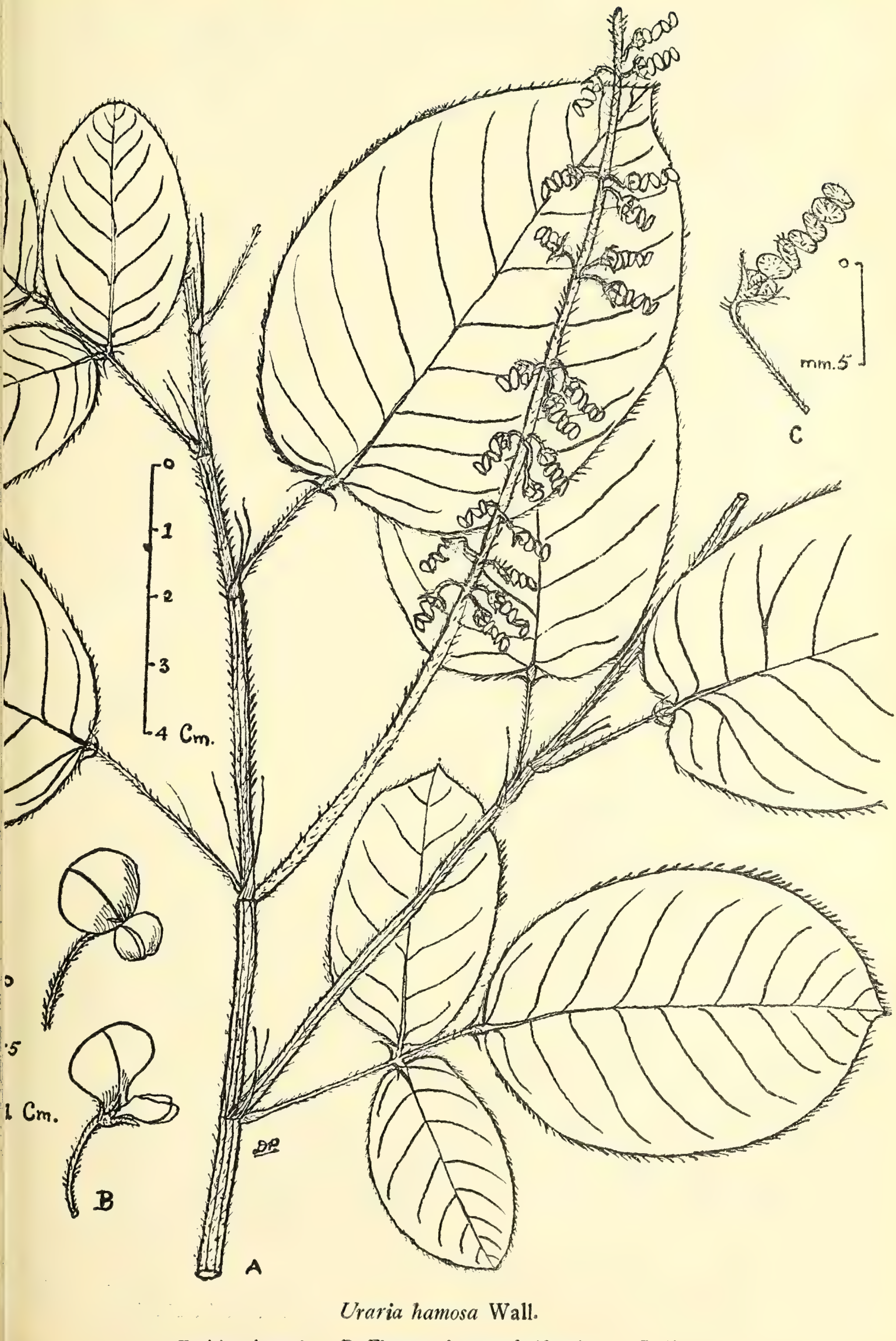
This is a further continuation of the series of new records of plants for Bombay State. In the course of the last few years we have been conducting a very intense exploration of various parts of the State. A good number of research students have been helping in this investigation, and have helped in the preparation of this note; their names are appended after each plant mentioned in the body of this paper, so that credit may go to them for the good work they have done. The line diagrams have been drawn from the fresh plants, and represent what to our mind are the typical characters of the plant in question.

1. **Uraria hamosa** Wall. Cat. 5681 B, 1831–32; Wight et Arn. Prodr. 222, 1834; Wight, Icon. t. 284; Fl. Brit. Ind. 2 : 156 (Plate I).

*Hedysarum hamosum* Roxb. Hort. Beng. 57, 1814, nom. nud.
*Doodia hamosa* Roxb. Fl. Ind. 3 : 367, 1832.
*Desmodium hamosum* Loud. Hort. Brit. 310, 1830.
*Uraria desmodioides & U. lanceolata* Grah. in Wall. Cat. 5682–5683, 1831–32.

Erect *shrubs* or undershrubs, 122–275 cms. high, branching profusely; *stems* woody, solid, angled, minutely hispid, the hairs slightly hooked. *Leaves* uni- and tri-foliate on the same plant; leaflets 4–11·5×2·2–6·5 cms., elliptic or broadly ovate, acute, mucronate or emarginate, base cordate or rounded, nerves 9–16 on either side of the central main nerve, upper side of leaflet glabrescent, lower one densely pubescent especially along the midrib; stipules 0·4–2·1 cms. long, deltoid-cuspidate, densely hairy persistent; stipels 0·3–0·6 cms. long, hairy, lanceolate; petioles 1·8–3·8 cms. long, grooved on the upper side, hispid; petiolules 0·2–0·4 cms. long, slightly swollen, hispid. Flowers in racemes, which are 10–30 cms. long, axillary, lateral or terminal, hispid, panicled. Flowers 2–4 in distant fascicles; bracts ovate, cuspidate, pubescent, caducous; pedicels 0·2–0·5 cms. long, incurved at the apex, hispid. Calyx 0·2–0·3 cms. long, not longer than the first joint of the pod, campanulate, hairy; teeth 5, subequal, deltoid-cuspidate, the lower 2 joined and short. *Corolla* mauve, exserted, 0·3–0·6 cms. long. *Stamens* 9+1, alternating long and short; anthers uniform. *Ovary* sessile; style nearly twice as long as the stamens persistent in fruit; stigma broad. *Pod* twisted, 4–7-jointed, joints alternate brown and black, minutely hispid.

The pod is the most typical part of the plant, and in every respect resembles the other species of Bombay. It is indeed remarkable that the plant has not been described before for Bombay; it seems to be widespread in the State, as the following list of herbarium specimens examined by us will show: North Kanara, *T. R. D. Bell* 2520, May 1917; Salsette Island, *Santapau* 995, 997 from Makal Caves near Andheri, Sept. 1942; Dangs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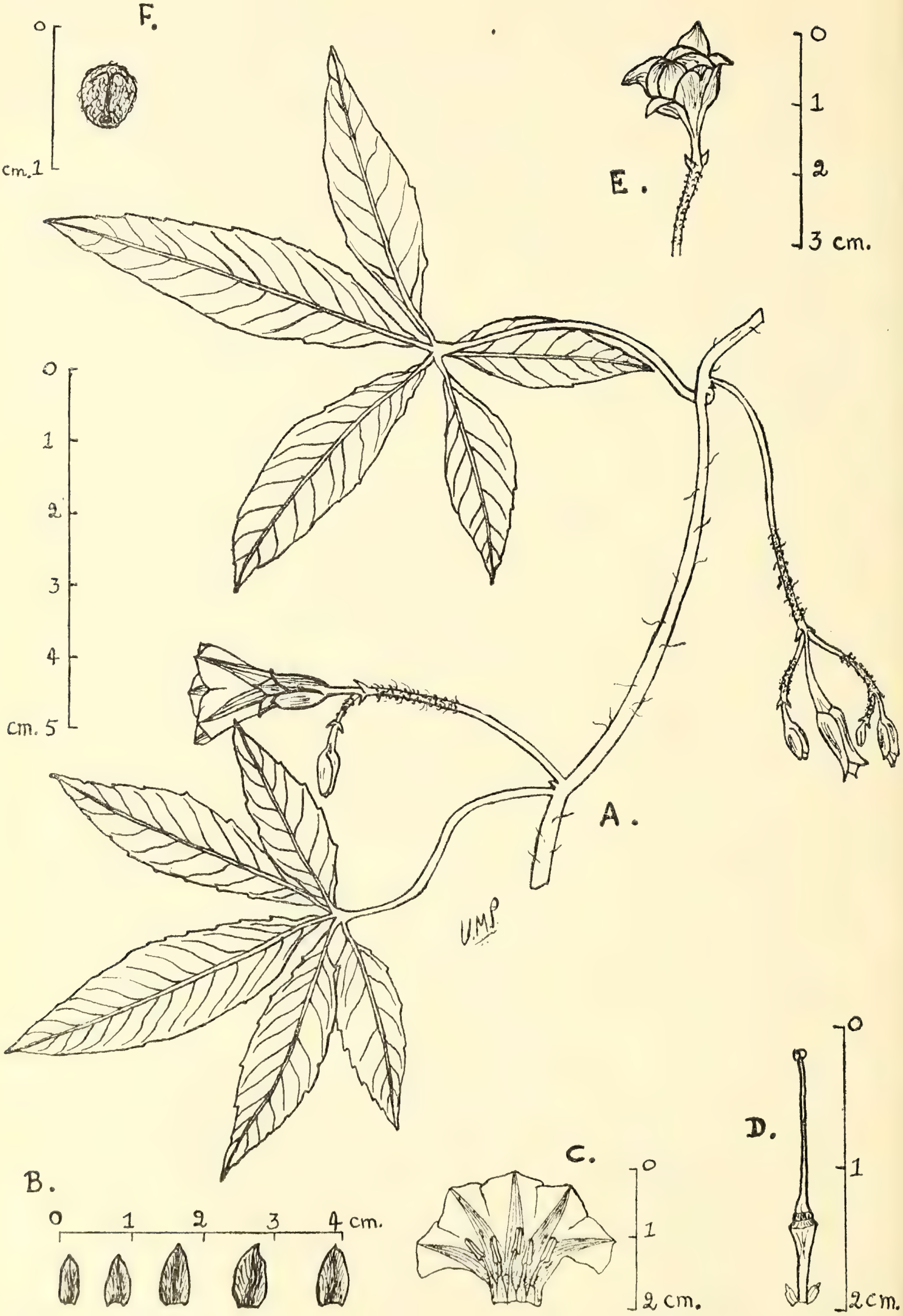
*Uraria hamosa* Wall.

A. Fruiting branch ; B. Flowers, front and side view ; C. Fruit.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*Merremia quinquefolia* Hall. f.

A. Branch with inflorescence; B. Sepals showing the outer surface; C. Corolla with stamens; D. Ovary with pedicel and bracts; E. Fruit; F. Seed from the inner surface.

Forest, *Santapau* 17338-17339, Nov. 1953; Waghai in the Dangs, *Panthaki* 1726–1729, 19th Oct. 1954; Sasurda, *Panthaki* 1748, 20th Oct. 1954.

The plant has been found to be common in clearings in the Dangs Forest, and along the railway line. It has been seen nearer Bombay in the undergrowth of thin deciduous forest.

(MISS) D. P. PANTHAKI, B.SC.

2. **Merremia quinquefolia** (Linn.) Hall. f. in *Bot. Jahrb.* 16: 552, 1893; Ooststroom in *Blumea* 3: 324, 1939 et in Fl. Males. 4 (4): 446, f. 28, 1953. (Plate II).

*Ipomoea quinquefolia* Linn. Sp. Pl. 162, 1753.
*Convolvulus quinquefolius* Linn. Syst. ed. 10, 923, 1759.

A herbaceous climber. *Stems* slender, twining, terete, glabrous or sparsely hairy, not thickened at the nodes. *Leaves* alternate, petiloate, palmately compound; petioles 3–5 cms. long, slender, glabrous and faintly grooved on the upper side; leaflets sessile or subsessile, glabrous, narrowly oblong to lanceolate, 2–6 × 0·5–1·5 cms., attenuated at the base and apex; apex acute to subacuminate or often obtuse; margins irregularly serrate, coarsely dentate or undulate or nearly entire. Inflorescence axillary, cymose, 1- or often 3–5-flowered; peduncles about as long as the petioles, but elongating in fruit, 3·5–7 cms. long, branching, glandular and slightly hirsute towards the apex, the branches also glandular. *Flowers* pedicellate, bracteate, creamy yellow in colour; floral buds ovate, acute; pedicels glabrous, 3–7 mm. long, extending to 10 mm. and becoming somewhat thicker at the apex in fruit; bracts triangular, acute or acuminate, about 1 mm. long. *Calyx* tubular; sepals 5, narrowly ovate, elongated, acute, mucronulate, glabrous, subequal, the outer 2 slightly shorter than the inner ones; outer sepals 4–6 mm., inner ones 8–9 mm. long, somewhat enlarged in fruit. *Corolla* creamy yellow, 16–20 mm. long, infundibuliform, 15 mm. in diameter, with lineate, glabrous corolla bands and shallowly lobed; corolla tube glabrous. *Stamens* 5, subequal, epipetalous, inserted about 3 mm. above the base of the corolla; filaments dilated and hairy at the base; anthers some times spirally twisted. *Ovary* glabrous, style 1 cm. long; stigma 2-lobed, the lobes globose. *Capsule* straw-coloured, globose, 4-celled, 1 cm. in diameter. *Seeds* 4, each about 4 mm. long, brown or black, covered with short, appressed, curly hairs.

This plant is being reported now for the first time from Western India. In point of fact, however, it is quite a common plant, though in Blatter Herbarium many of the specimens of this species have been placed under *M. tridentata* Hall. f. or *M. aegyptia* Urban, or under various species of *Ipomoea*, particularly *I. dissecta*, which it much resembles.

We have examined the following specimens from Western India:

SAURASHTRA: Sasangir, in the Gir Forest, *Santapau* 15152; Dwarka, *Dhruna* 12; Rajkot, *Santapau* 13559 and 16885.

RAJPUTANA: Abu Road, *Blatter* 22133.

SOUTH GUJERAT: Baroda, *Patel* 1176–1180; Pavagadh Hill, near Baroda, *Patel* 1190–1192.

KONKAN: Thana, from a garden, *Patel* 1323–1328; Bombay, *Ackland* 1447 and *Blatter* 14550.

(MISS) V. PATEL, B.SC.

3. **Eupatorium repandum** Willd. Sp. Pl. 3 : 1767, 1804; DC. Prod. 5 : 45, 1836 (Plate III).

Family Compositae. An annual, erect undershrub, 50–75 cms. high. *Stems* branched, terete, pubescent. *Leaves* opposite and decussate, shortly petiolate, lanceolate-elliptic or ovate-elliptic, acute or shortly acuminate, 4–7 x 1·5–3·5 cms., glabrous on the upper, silky pubescent on the lower side; the lower leaves deeply sinuate-dentate, the upper ones shallowly serrate-dentate; base tapering into the short petiole. *Heads* homogamous. about 1 cm. long, cylindric, arranged in terminal corymbs; peduncles 1–5 cms. long, hairy. *Involucre* multiseriate, the innermost series of bracts the longest; all the bracts oblong-lanceolate, obtuse, 3-nerved from the base, scarious, varying in length 2–7 mm.; receptacle convex, pitted, naked. *Florets* all bisexual. Pappus 1-seriate, consisting of numerous setose hairs about as long as the corolla tube. *Corollas* tubular, white to pale violet; tube 4–5 mm. long, narrow; lobes 5, triangular-ovate, acute, pubescent outside, 1–2 mm long. *Stamens* 5; anther bases sagittate; auricles narrow, obtuse. *Style* arms 2, very long and far exserted, subulate and hairy. *Achenes* black, hispid on the angles, 4–5 mm. long, crowned with the pappus.

This is a Central American plant, that has been found growing probably as an escape near gardens at the entrance to the National Park, Borivili, near Bombay. *Randeria* 577, collected in flower on December 12th, 1943.

(Miss) A. J. Randeria, m.sc.

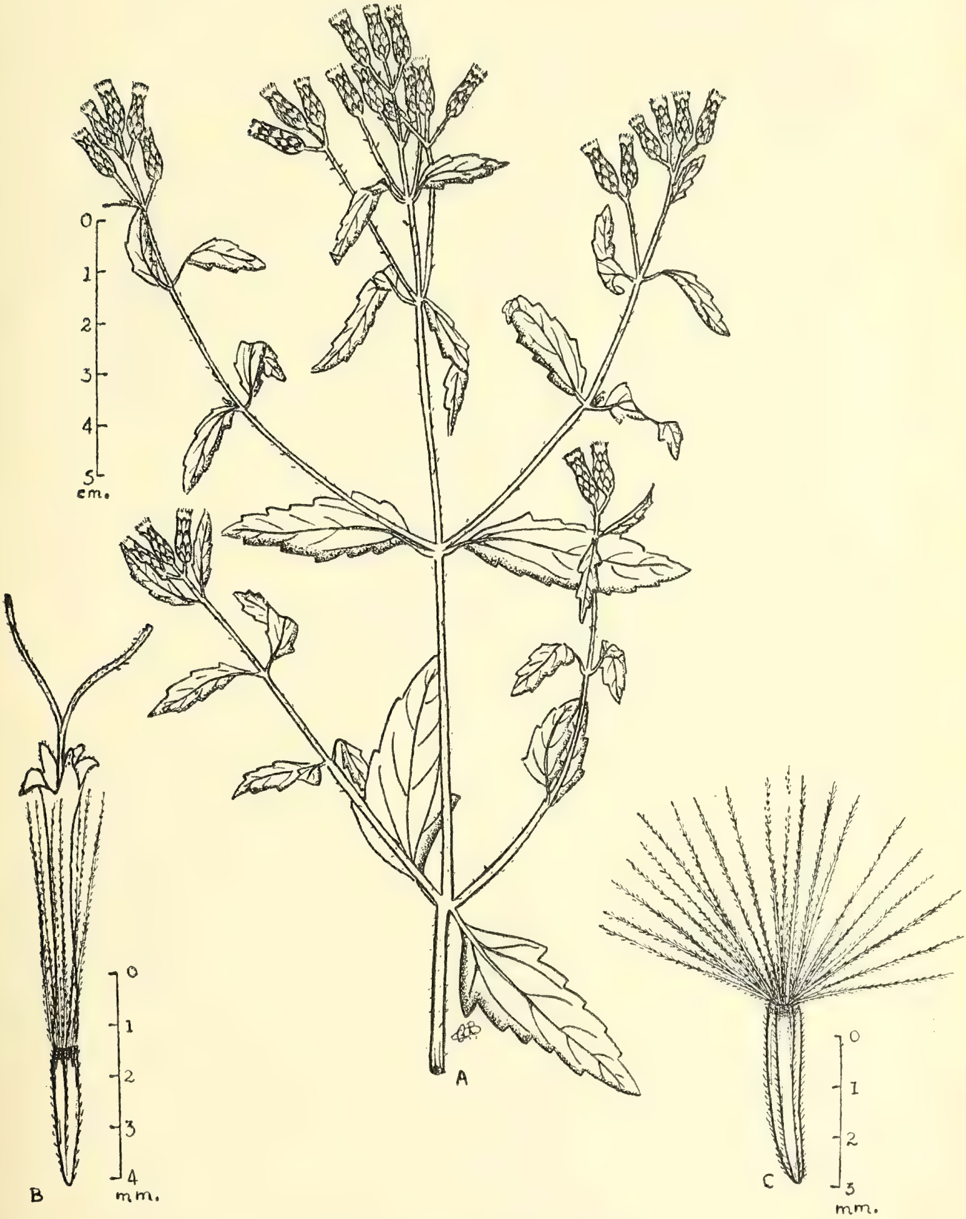
4. **Hymenatherum tenuifolium** Cass. Dict. 22 : 313, 1821–1822; DC. Prodr. 5 : 642, 1836. (Plate IV).

Family Compositae. An annual erect herb, 15–20 cms. high. *Stems* cylindrical or subquadrangular, simple or branched, obscurely ribbed, finely pubescent with short minute hairs. *Leaves* sessile, the upper ones alternate, the lower ones more or less opposite, all deeply pinnatisect, 2–5 x 1–3 cms., lobes opposite, more or less filiform, glabrous or puberulous. *Heads* heterogamous, rayed, about 2 cms. in diameter, terminal; peduncles bracteate or naked, 5–9 cms. long, generally glabrous; bracts 2–3 mm. long, lanceolate-subulate. *Involucres* uniseriate; involucral bracts partially connate at the base, oblong-cuneate, 3-lobed at the apex, 6–7 x 3–4 mm., ciliate at the margins, reticulately veined; receptacle naked. *Pappus* copious, 1-seriate, consisting of setose unequal hairs about as long as the corolla tube. *Corollas* yellow; those of hermaphrodite florets tubular, their tubes uniformly dilated upwards, glabrous, 2–3 mm. long; lobes 5, ovate, acute, spreading, more or less 1 mm. in length; corollas of female florets ligulate, 3-notched at the apex, 6–9 x 1·5–2·5 mm. *Stamens* 5; anther bases obtuse or slightly tailed. *Style* arms 2; those of hermaphrodite florets ciliate and truncate at apex; those of female florets subulate, glabrous. *Achenes* oblong, angled and ribbed, black, hispidly hairy, 3–4 mm. long.

This herb is original of Central America, and has been found in the Krishnagiri National Park, Borivili, near Bombay, growing not far from the entrance to the Park; it has been seen in flower and fruit during the rains and seems to be well established on Pavilion Hill of the Park.

*Randeria* 57, collected on 23rd August 1951, and *Randeria* 441, collected on 7th October 1952.

(Miss) A. J. Randeria, m.sc.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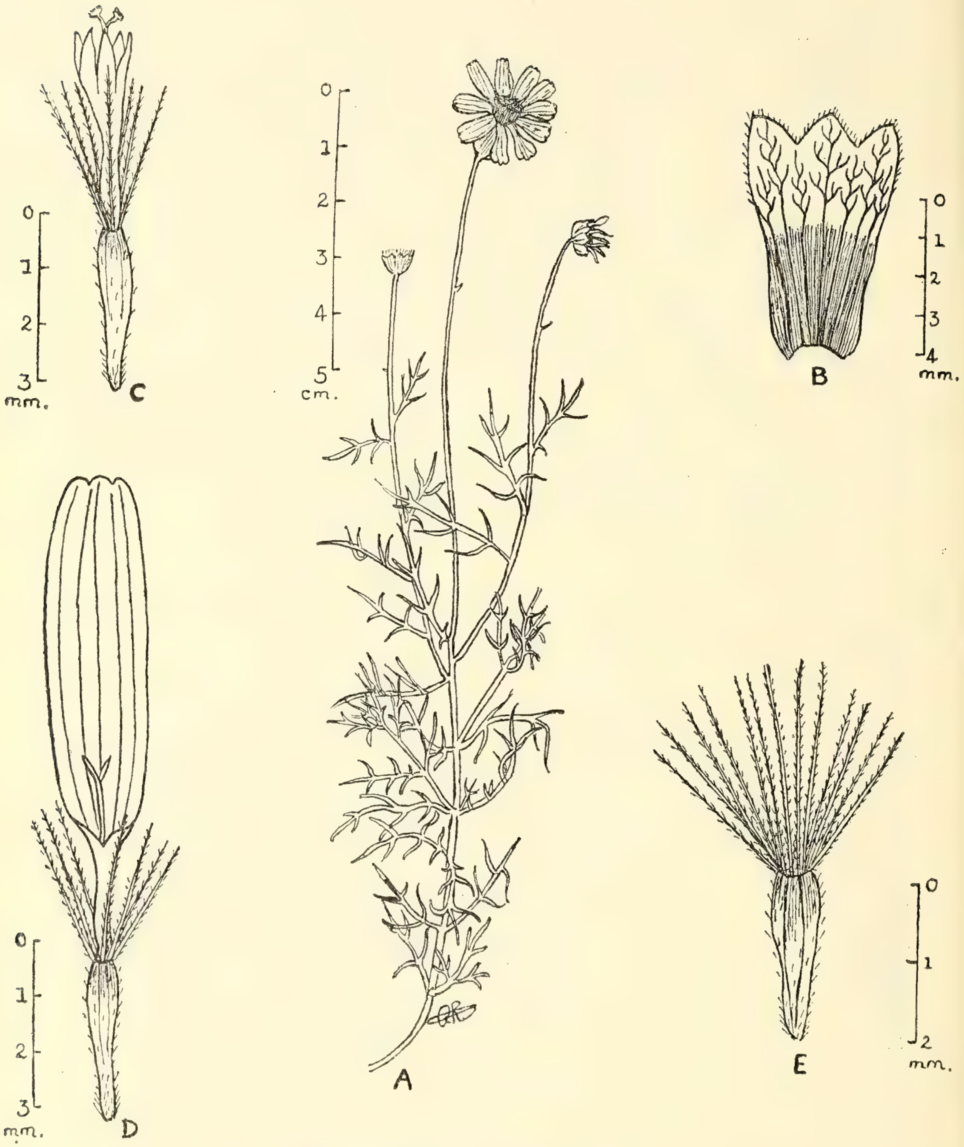
*Eupatorium repandam* Willd.

A. Flowering branch ; B. Floret ; C. Achene.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*Hymenatherum tenuifolium* Cass.

A. Flowering branch ; B. Involucral bract ; C. Disc floret ; D. Ray floret ; E. Achene.

# TROUT FISHING IN KASHMIR

BY

PHILIP K. CROWE

It was difficult to improve on the fabulous Himalayan pleasure land of Kashmir, but two men succeeded in doing it. The Mogul Emperor Jehangir built the lovely Shalimar, and an Englishman named Mitchell imported brown trout. The result is that today one can wander among the flowers and fountains of the famous garden by the Dal Lake or, as I prefer, angle along some of the world's most sporting and spectacular streams and rivers.

Simply getting to Kashmir from the Island of Ceylon, where we now live, took a bit of doing. The distance from Colombo at 6° north latitude to Srinagar, capital of Kashmir, at 34° north is 1,848 miles but, as we were tied to commercial air travel, the trip was nearly a quarter longer. Flying first to Bombay and then to Delhi, where we spent the night as guests of Ambassador Cooper and his attractive wife, we finally took off on Indian Airlines for the flight to the Vale of Kashmir. From Jammu, the last airfield in the plains of India, we climbed rapidly (without pressurized cabin or oxygen) and sailed over the nine thousand foot Banihal Pass. On either flank snow-capped peaks towered over us, while below, like the teeth of a vast brown shark, lay other jagged summits. Our enjoyment of this superb vista was somewhat lessened by the knowledge that if the pilot found fog at the end of the pass he would have to turn around and return to Jammu. We were lucky, and, though we coasted through a white blanket of cloud for a few minutes, it soon tore apart and we looked down on the sparkling valley that is the Vale of Kashmir. Emerald green paddy, and fields of crimson poppies and yellow mustard, lay spread below like some gorgeous tapestry. Well did the Mogul Emperor cry, ' If there be paradise on earth, this is it, this is it, this is it.'

We—my wife Irene and my daughter Rene and I—were met at the airport by G. M. Butt, a cordial white-bearded Kashmiri whose house boat, the *Clermont* we were to make our base during our 17 days stay in Kashmir. I might add that Mr. Butt specializes in Americans, having had Adlai Stevenson and George Allen, former Ambassador to India, as his guests. What is more, his boats, moored on the edge of the Dal Lake, are extremely comfortable and his food excellent. Said Mr. Stevenson in the guest book ' an enchanted interlude that mended body and mind.'

Kashmir has some three hundred miles of trout water ranging from altitudes of above eight thousand feet to about five thousand. Most of these streams are within sixty miles of Srinagar and are laid out in ' beats ' or two-mile stretches, which can be rented from the Government. There are other streams, however, that were formerly the private preserves of Maharaja Hari Singh and are now reserved for State guests.

The best of these—the Tricker, the Nambal, and part of the Liddar—are located in the lovely Liddar Valley and provide some nineteen miles of superb fishing. There are also certain very good streams such as the Kukernag and the Kotsu, in the Liddar Valley, and the Verinag in an adjoining valley where the fishing, open to the public on a limited basis, is very good. The last category of streams are those open to the public at all times and include most of the Liddar, and the Bringhi in the same general area—about fifty miles southeast of Srinagar—as the streams mentioned above. Northwest of the capital is the famous Sindh River where there are a number of good public beats, and near the mountain resort of Gulmarg, twenty miles from Srinagar, is the Tanmarg, which holds some good fish even though the altitude is over eight thousand feet. The Kuragbal district in the far north of the state is closed as it runs along the Pak-Indian cease-fire line and the Madmatti and Erin streams, which lie south of it and empty into Wular Lake, the largest fresh water lake in India, have not yet recovered from the disruption following the invasion of the tribesmen during the partition troubles of 1947. There is also said to be some good public fishing near Vishensar, but the trek to it takes several days on ponies.

Through the kindness of His Excellency Sri Chakravarty, High Commissioner of India in Ceylon, a wire was sent in my behalf and, when I called on Mr. G. M. Malik, chief of the Fish Preservation Department of Kashmir, I was told that I would be allowed to fish in some of the reserved waters as well as the public ones. Col. Harry Nedou also wrote for me to Wazir Amin Chand, Controller of the Household of His Highness the Yuvaraj. Another friend who went out of his way to help me arrange my Kashmir fishing was F. C. Badhwar, former Chairman of the Indian Railway Board and one of the keenest fishermen I know. Also most useful from a fishing standpoint was a book called 'Kashmir Cameos' written by my friend H. C. Hockley of Ceylon.

On the crystal clear morning of Friday, May 13, 1955, we took off in an old Chevrolet station wagon for Verinag, a stream some forty-seven miles south of Srinagar. We had been unable to book the government rest house there so decided to camp out, and our tents and camp furniture were piled on the roof of the car. Momdu, Mr. Butt's number one servant and a shikari with a great deal of camping experience, was in charge. There was also Sultana, the cook, and Mohamed, the chauffeur. The road to Verinag is the road to Jammu and runs straight down the Vale of Kashmir to the Banihal Pass where we swing left instead of continuing over the pass into Jammu. For a great deal of the way poplars line the road and the fields on either side were ablaze with poppies and blue and white iris marking Moslem graveyards. We passed herds of sheep and goats, tended by wild-looking men from the mountains, and once a gypsy encampment with the curious little igloo-shaped felt tents that are the homes of gypsies in this part of Asia.

As we passed through the mountain terrain just below the Banihal Pass we saw some dangerous washouts. Twenty years ago when I made the trip over this pass in a model T Ford the road was so bad that we took three days to do the trip and barely crawled around the corners. It is because it is so difficult to maintain the road in avalanche country that the Indian government is now engaged in building a tunnel under the mountain that will allow year-round surface access to the Valley. A German firm has the three-year contract.

Verinag, the source of the Jhelum, is a spring-fed stream born in a great fifty-four foot deep chasm around which is constructed a circle of Mogul arches. The stream is then led by canals through a lovely garden built by the Emperor Jehangir and finally spills out into its own bed where it provides a series of fast runs and deep pools.

There are some huge fish in the spring itself, which, over the centuries, have come to have religious significance to the Hindus. I watched an old man feeding them with rice, and, looking down into the green depths, saw submarine sized fish turn lazily to accept the offering.

Abdul, the old watcher, met us at the edge of the stream and after examining my permits carefully—he was apparently amazed that anyone was allowed to fish there as the stream had been closed for two years—beamed at me and immediately supplied me with Rishu, his best shikari. I noted in his fishing book that the last person to fish the Verinag before it was closed in 1953 was our friend the Maharaja of Indore who enjoyed some fine sport, his best catch being a thirteen pounder that he will undoubtedly remember for many years to come.

I had been advised by Mr. Ogden, the British manager of Lloyds Bank in Srinagar that big gaudy hires hooked the big fellows in Kashmir, and accordingly I had purchased a dozen monsters made of peacock feathers. Rishu had shaken his head sorrowfully when I tried to tie on an Alexander, one of my favourite Ceylon flies, but broke into a broad grin and nodded his head savagely when I finally produced a peacock. Tying this to a 2-X gut leader and adding a little lead wire near the fly, I was set to attack.

It had rained for several days and the water, even though it came from a spring, was so coloured that it seemed impossible that a trout could see even my whiskbroom-sized lure. My first cast, however, showed me that the fish of Kashmir have better eyes than they do in America. A lively one-pounder broke water, curved over the fly, and dragged it under with a jerk. I played him for a while and then let Rishu net him, an operation he performed with skill. The second cast also hooked a trout but he did not rise and it was not until I started to put strain on him that I realized that I was on to a big fish. I found that I could not lead him but kept all the strain on him I dared while he went where he liked. Starting at the head of the pool, which was about fifty feet long, twenty feet wide, and perhaps ten deep, the trout swam rapidly to the foot, hesitated a moment, and then ran down the swift water into the next pool. I had only thirty yards of tapered line but luckily had my waders on so was able to plunge after him despite the icy water. In the next pool he played the same game and, after swimming around lazily for a few turns, took off again down the river. It was during his second run that I first saw him—a flash of yellow belly and a great beak of a mouth. He was visibly tiring and at the head of the third pool Rishu got his net under him and with a two handed scoop brought my prize to shore. He tipped the scales at 3½ pounds, a nice trout if I say so myself.

It was only after the trout was landed that I happened to look around and realize that I had an audience. There were a good fifty Kashmiris observing the proceedings from either bank and a mutter of approval broke from them as we triumphed over the big fellow.

I caught eight more fish averaging two pounds, but let them go. There was no point in keeping more than we could eat and four and a half pounds of fish is a good breakfast for six in any country. At noon rain clouds gathered and I quit for the morning. While I had been fishing, camp had been pitched and a better location would be hard to find. Behind the tents a forest of fir trees climbed toward the snow peaks and before them lay the sweep of the river winching away between the poplars to the village of Verinag.

In the late afternoon, when the shadows were beginning to creep down from the peaks, I fished again; this time taking Momdu as shikari. We were interested only in a really big fish and accordingly tried only one pool, the one below a long race where the roots of a huge Chinar tree formed a subterranean chasm through which the white water thundered. I allowed the fly to drift under slowly, and then pulled it back to me with short jerks. The fly was almost out from under the roots when there was a surge and a big trout sucked it in and made off up the pool. This pool was long and deep and the trout had no desire to leave it. For ten minutes he wore himself out against the current and then came in nicely to the net. Weighing in at 3 pounds, he was a prize worth having.

Back at camp, we sat before the tents, admired the light of the setting sun on the snow fields and sipped well-earned scotch whisky and spring water. My wife and daughter who are not particularly fond of fishing informed me that they had put in a happy day. Irene sketched and Rene rode one of the little Kashmiri ponies. Sultana's dinner was a triumph of culinary art. He gave us fish soup, fried trout, sishkababs and rice, carrots, new potatoes, spinach, toast, fritters and coffee; all of which was produced on a wood fire converted by a sheet of metal into a semblance of a stove. Furthermore Momdu encircled his waist with a blue cummerbund, added a turban, and served us with great pomp and ceremony. I confess I never miss the 'come-and-get-it-school' when something better is available.

Night came and the air, which is always brisk at six thousand feet, turned icy cold. We piled on blankets, closed the flags of the tent and slept. The last thing I heard were the drums beating in the nearby village for the end of the day's fasting. It was Ramzan and good Moslems could not partake of food or water until nightfall.

The first day's fishing had been on the Number One beat of the Verinag and the second day I went several miles down the river to the Number Two beat. The river down there, having been fed by numerous freshets from the snows, carried a far heavier head of water and I had to add lead to my leader in order to sink the fly. The scenery also changed. Instead of the villagers' gardens through which the head waters ran, the stream now wound between endless fields of paddy whose brown waters reflected the snow peaks like so many copper mirrors. It was a lovely sight and for a few minutes I almost forgot to fish.

My first strike was in fast water and the fish, which I never saw, broke me with ease. Fitting another leader and trying on the proverbial peacock at the tip and a brown hackle on the dropper, I cast again into the wild water. Hardly had the flies sunk out of sight when two fish hit them and, even though one shook itself off, I netted a fine two pounder. And so it went during the long clear Kashmir morning. I kept four fish, all over a pound and my best was two and a half pounds. I lost four fish, all, of course, monsters, and threw back sixteen fish. The smallest trout I caught was ten inches long, and I threw him back to grow up.

In the late afternoon we broke camp, drove thirty miles to the Liddar Valley, to camp on the Tricker River near the burned out ruins of the late Maharaja's Rest House. It is a beautiful location and has the added advantage of being several miles from the nearest village so that we were spared the crowding of the curious. However, the head watcher, Kudusmere, appeared as if by magic from the middle of a field of bright yellow mustard. In no time a working gang of five had been recruited to get up the tents, provide Rene with a pony, and erect my collapsible chair and desk so that I could write this log. As I mentioned above, the Tricker used to be one of the Maharaja's personal streams and is still reserved for guests of the government. The record brown trout caught on beats number 5 and 6, which were allotted me, was ten pounds.

As the sun set I took Rene out for a little practice and she hooked and landed two good trout at once on her first cast. The stretch of stream in front of camp fairly teemed with fish but they were not above a pound and small for the Tricker. The next day was Rene's thirteenth birthday and Momdu celebrated the event by having the cook bake a magnificent fish cake, replete with candles—which he borrowed from a nearby shrine.

The snow water is so cold that fishing is not good until the sun has warmed the stream a bit and it was nine-thirty before Kudusmere and his two retainers—one for carrying my kit and one for carrying the fish—led me down to the confluence of the Tricker and the Liddar, where the waters of the two streams meet in a great pool.

At this point I must say a word about tackle. Some years ago I bought an Orvis 'Battenkill' fly rod. Made of impregnated bamboo, weighing 3¾ ounces and 7½ feet long, the rod has served me well under conditions ranging from the tropical heats of the low country rivers of Ceylon to the Himalayas. I have used it for seer fishing in the Indian Ocean and for bass in Maryland. For trout I fit it with a British made Young Beaudex reel and tapered casting line.

The Peacock lure, which proved such a killer on the Verinag, did not please Kudusmere and he insisted on a Golden Lion lure with a Watsons Fancy on the dropper. The Golden Lion, I might add, is just as fantastic looking an affair as the Peacock, only more so. A medley of tawny colored feathers tied to two golden bound hooks, it is a device to tempt a shark. Kudusmere also objected to my 2-X leader. 'All right little fish of Verinag' he said but here 'him bust quick.'

However, I decided to try with the 2-X and accordingly cast out over the pool and drew the line in slowly, allowing the flies to sink about six inches below the surface. There was a surge, a sharp pull and the new Hardy gut leader parted with a ping. Changing to 1-X I was soon on to another fish, and after a good battle Kudusmere netted a fine three and half pounder. By noon the coolie carrying my kreel was staggering under 18½ pounds of fish (presents for friends in Srinagar) resulting from a grand morning's sport; the total included a 4 pounder which was netted just as the leader parted, a 3¾ pounder that led me into a pool above my waders, a 3½ pound rainbow, the only rainbow I caught on this beat, and four good fish ranging from 2 to 2¾ pounds.

After a succulent lunch of fish and duck curry we slept for several hours, and it was not till four that I invaded the stream again. This time we went directly to the Liddar with the intention of bettering my erstwhile record of four pounds. Starting to fish at the foot of a long run of heavy water, I caught several two pounders which I released, and was just about to move on down stream, when my dropper fly, which was dancing along the water, was suddenly sucked under with a splash. That the fish was a big one was obvious when I tried to check him. Paying no more attention to me than a runaway horse, he took off up stream and churned his way against the current like an ice breaker. Before he breasted the white water into the next pool I saw his dorsal fin and the square of his tail. It was a shattering experience.

This was a great fish and the thought of losing him nerve-wracking. Even Kudusmere, who has been a shikari for forty years and head watcher of the Tricker for ten, was moved to excitement and implored me to be careful. I was as careful as one could be with a limited footage of line and a plunging whale at the end of it. My main worry was the leader; would it take the strain ? Once the line went dead and I feared the fish may have thrown the fly but the line had caught on a rock, and was soon freed. Then, all of a sudden, the fish tired and I was able to move him slowly towards the bank where Kudusmere waited, net in hand. Creeping up behind the weary giant, he slid the net under it and then, using both hands, lifted it from the water. Superlatives should be saved for someone else's fish so I will simply say that it was a fine trout and weighed 5½ pounds.

Back in Srinagar I lunched with His Highness the Yuvaraj, the constitutional head of the government, and thanked him for his permission to fish the state streams. Formerly a keen angler himself he was interested to hear of my luck. In recent years, however, he has given up both hunting and fishing as they are inconsistent with the Hindu religion.

The closest trout stream to Srinagar is the Sindh River, some thirteen miles out, and even though it is open to the public and is therefore overfished, I decided to have a day there. It was a glorious clear morning when we drove up the Sindh Valley. This is the road to Leh and I was amazed to see how much it has been improved since I last travelled over it by pony in 1935. In those days it took several days to reach the border of Ladakh at Sonamarg, and today one can drive the 52 miles over a good metalled road in an hour and a half. Near the village of Ganderbal we were met by the watcher, a fine old shikari named Ramon, and a pony for Rene.

The Sindh is a big river, and since spinning is allowed there, I had little hopes of a decent bag. Ramon told me, however, that, as most people did spin, they only fished the long deep pools and he advised me to try my flies—the old favorite Peacock and Watsons Fancy, on the fast water. I did just this and caught six fish in the course of the morning. The largest was only a pound and a half and the smallest just over half a pound, but in aggregate they made a good mess for lunch. There are some big fish in the Sindh. The son of Sheikh Abdullah, the former Prime Minister of Kashmir, caught a 12 pounder there a month previously. Mr. Butt, who had come along with us for the day, supervised the cooking of the trout and we ate them in the shade of an old mulberry tree. There is a small silk industry in Kashmir and the leaves of these trees are used to feed the silk worms. Then, as I was feeling a bit tired, Mr. Butt advised a massage and I was surprised to learn that most fishing shikaris have been trained to give their sahibs a reviving pummelling. Ramon gave me a fine one and I soon fell asleep.

In the afternoon we fished for an hour more and then called on Madelaine Slade, the British Admiral's daughter, who under the name of Mira Ben was one of Gandhi's most cherished disciples. She now runs a cattle-breeding farm for the Kashmir Government. Being a vegetarian, she refused my offer of trout but gave us tea and several hours of fascinating reminiscence. She was not greatly changed from the time I first saw her twenty years ago with Gandhi in the Untouchable settlement outside of Delhi.

Our next outing was to last five days and take us back to the Liddar Valley where we had permission to fish the Nambal, the favourite stream of the old Maharaja and the number one trout stream of Kashmir. We also intended to fish the Kotsu and Kokernag. The station wagon we had used on our last trek was not up to this trip and Mr. Butt produced a sturdier, even though older, vintage of Chevrolet. There was also a new driver, who gloried in the unusual name of Mohamed, was 20 years old and wore a green shirt that was dirty even for a Kashmiri driver. He could drive, however, and manipulated his top heavy jalopy through the sheep, donkey caravans, and army convoys as if it were a Cadillac town car. Momdu was again in charge, and Sultana cooked.

Since the 1947 troubles, the trail to the Nambal had been allowed to deteriorate, and soon after we turned off the main road to Pahlgam we found ourselves facing a washed out bridge. There was only one alternative and that was to build up the bed of the stream. Thank God it was dry, and, a tribe of Kashmiris having appeared from the fields, enough stones were added to allow us to negotiate the hazard. Four rickety bridges and some six miles of terrible road later, we arrived by the banks of the Nambal. Behind a wooden fence we saw the Maharaja's rest house, but had decided to camp and pitched the tents on the edge of the stream.

We were situated only some ten miles from our former camp on the Tricker, and had the same horse-shoe of snow peaks on three sides. The nearby mountains, however, were densely wooded with pine, and as the sun set I heard the cry of chakor partridge. The old rest-house keeper, who told me with pride that he had been with the Maharaja for thirty years, said there were bears on the mountains and when the corn was ready for harvesting they came down to the fields and sometimes attacked the villagers. I told him that if by chance one of the bears mistook the season and appeared early, I was ready for him. It always pays to be ready for emergencies and I had brought along my 8 mm. Mannlicher.

The Nambal is not really a river with a source of its own ; it is merely a branch of the Liddar, which runs for some five miles on a loop from the main stream. For those five miles, it carries the best head of trout in Kashmir. In addition to this Nambal, however, there is a Little or 'Chhota' Nambal, whose origin was duly explained to us.

'The Chhota Nambal,' said Kudusmere, who was head watcher for that stream as well as the Tricker and had galloped over on his pony when he heard we had come back again to his bailiwick, 'was made by the Maharaja, not like the Tricker, which was made by Allah,' and even a casual survey of this perfect trout stream would reveal that a power other than nature had laid it out. Every hundred yards there were man-made dams of stone which stretched part of the way across the stream only leaving a race-way in the middle. The result was some five miles of pools which could be fished with the greatest of ease. There was no underbrush nor trees to catch one's fly on the back cast, and a grass trail, as smooth as a tennis court, followed along the sides of the pools. An invalid in a wheel chair could catch trout on the Little Nambal. The Little Nambal was laid out as to dams, channels, pools and runs before the water from the Liddar was diverted to it. When it was finished some fifteen years ago and His Highness caught his first trout in it he, like the

Moguls contemplating their gardens, must have sat back and murmured words about a fish paradise.

Tempting as the Nambals were, I decided on our first morning's fishing to eschew them and return to my old love the Liddar. My fishing diary of May 20th records :

Weather—Clear, warm in the sun but crisp in the shade, white clouds over the snow peaks.

Streams—Gin clear in places, but green-grey from snow water where feeding streams come in.

9.30 a.m.—3 pounder. Time from strike to netting seven minutes. Fly-silver doctor lure. At the same time my daughter Rene caught a two pounder.

10.30 a.m.—Two one and a half pounders on Watsons Fancy.

11.30 a.m.—On the run just below the Tricker confluence, a very heavy fish. Netted after fifteen minutes and tipped scale at 6 pounds. Length 23 inches and my best fish to date.

12 noon—As artificial minnows are allowed in the Liddar, I tried a Golden Deven and immediately caught a two-pounder. There is no charm in casting this object, however, and I quickly returned to flies.

In the afternoon I had my first whack at the Big Nambal and everything I had heard about it was an understatement. I really believe that it maintains more trout per square foot than any river, outside of Alaska, that I have ever fished. The second my fly hit the water there was a surge, and, if that fish missed, there were a series of other surges before I retrieved it. I only fished two hours that afternoon. The total number I caught was fifteen and I weighed them to find a total weight of 40 pounds. There were no fish over three pounds. I threw them all back.

Late in the afternoon the weather turned menacing and a wind suddenly sprang out of the mountains and blew so strongly that I had no control over my fly. At the same time a grey mass of rain clouds piled up in the East but for some reason hung above the snow peaks so that for a little while the shining mountains, bathed in sunlight, were visible as if through a window. Later I learned that Irene and Rene had had a bad time at camp. The tents were only saved from blowing down by Momdu who piled stones all around the edges. The cook tent did blow down twice and Sultana had to retrieve it before he could start our dinner.

All food seems to taste good on a camping trip, but the cooking often derives its praise from hunger rather than skill. Incidentally menus in Kashmir are limited; the Hindus wont kill cows or allow beef to be imported, and the Moslems feel the same way about pigs. Sultana was a really good cook and, unlike some of his ilk, was only too pleased to tell me how he did it. His basic equipment would drive most chefs wild; it consisted of a flat piece of iron with four holes in it for pots. It was up to Sultana to find stones and firewood to complete his stove.

Sultana's fried fish, which we usually had for breakfast, was particularly delicious. He filleted the trout, fried them in deep ghee (butter) and added powdered chili, pepper and salt. My wife pointed out, however, that fried fish was not an art but that Sultana's baking of a great trout (the six pounder), without an oven, was. He put the trout in the largest pot he had and covered it over with an iron plate on which he kept piling live coals. The whole process took upwards of three hours. Onion, garlic, lemon, salt and pepper were added at the right times. His receipt for Rene's birthday fish cake was first to boil three two-pound trout, take out all bones, chop up the meat, mix six eggs with it, and the usual spices. No one could appreciate the conventional birthday cake of flour after one of Sultana's fish cakes. But of all his fish dishes, my favourite was fish pilau, a speciality of Kashmir cooking. The fish were boiled, boned, and cut into small pieces, then fried in deep butter in a curry mixture that included cinnamon, cardamom, and various unpronounceable spices. Served with the white hard rice of the country, it made a meal that induced a solid two hours of sleep.

St. Anthony was tempted, as we all know, but no one but a fisherman knows that a fisherman has frequently to face temptations of magnitude. I refer, as all fishermen will immediately realize, to the temptation of bait for the big ones. The fly fisherman, like the good Christian, has a certain code of morals and it does not include the taking of trout or salmon on any other lure than a fly, preferably a dry fly. Imagine, therefore, the crisis I had to face when, under the bridge at the place on the Little Nambal where the first beat ends and the second begins, I saw a submerged battleship of a trout cruising in five feet of clear water. All around me on the swampy ground were myriads of little frogs, the steak and potatoes of big fish. Furthermore, in my kit I had a wide variety of metal, cloth, and wool contraptions which would be hard for any monster to ignore. I looked at the trout and he looked at me and we both shook our heads : I just couldn't sink to the unspeakable (I might add here that nothing but flies are allowed on the Little or the Big Nambals) and he couldn't bring himself to bite on my flies. This was the impasse, when the watcher came along and tactfully suggested that I try a pool a little further on. He was a fisherman and knew my dilemma.

While on the subject of really big trout, I would like to express the opinion that in Kashmir, America, Alaska, Ceylon, and even perhaps in England few if any whoppers are caught on flies. In some thirty years of fishing—I caught my first worthwhile trout, a three pounder on a worm, when I was fifteen—I have never been able to tempt a really big trout with a fly. I have often managed to get their interest, but have never been able to induce a trout of over ten pounds to take a fly. Furthermore, the shikaris of Kashmir become strangely silent when pressed as to the exact lure on which the Maharaja of this, or Lord that, actually caught their record fish.

But I could not complain. My last evening on Nambal resulted in seven really good fish ranging from 3¼ to 5½ pounds, all of which I returned.

The following morning I was called at six and set off with Kudesmere for the fifteen mile drive to the Kurtsu. How Mohamed managed to guide the old Chev along those goat-trails I do not know. Kudesmere and I dismounted at all bridges, commended the car to Allah, and watched fascinated while it bucked over them. The Kurtsu is also in the Liddar Valley but at the far end of it, so I was able to get a broad impression of the country. Most of the land is dedicated to rice, and, with an adequate water supply, this is logical. There is also considerable grazing land and I noted herds of tough ponies, wiry goats and sheep and some of the thinnest cattle I have ever seen.

The Kurtsu is one of the prettiest and certainly the least rewarding trout stream in Kashmir. Flowing between groves of Walnut, Chinar and Poplar which filtered the amber sunlight, the stream is an artist's dream but a fisherman's despair. The trees effectually prevent casting and the village, which marches just behind the line of greenery, contributes some unappetizing odours to the scene. Despite these handicaps I managed to catch six trout of about a pound each, releasing all but the biggest which I presented to a small girl. I also caught several Chushu, a fish esteemed by the villagers but looking exactly like our suckers. The largest Chushu weighed in at four pounds and gave me quite a tussle before he was netted.

The watcher, one Shirkari, told of a great trout. ' This long, Sahib ', said he stretching his arms apart to their greatest extent. The giant was reputed to inhabit a pool under an old Chinar tree, and while I dangled a fly in it, I learned something of poaching. According to Kudesmere and Shirkari a lot of it goes on, not on their beats of course, but on virtually all others. And there is adequate economic incentive for it. A five pound trout brings three rupees, about sixty cents, in the market, with smaller and better eating trout appreciably more. Furthermore the fines, which in the days of Hari Singh, used to be rigorous, have been greatly reduced. But quite aside from illegal netting, the criminally inclined fisherman can make a profit quite legitimately. He pays three rupees for a day's license, allowing him to catch six trout. He then sells the trout for an average of a rupee each making a net profit of three rupees on the day's ' sport '. Since a common labourer gets somewhat less than this, there could be considerable appeal in the profession.

There were many birds in the trees along the stream and I noted the minivet, a little red breasted bird, and also hoopoes ; and far up in the sky hawks sailed. Falconry still goes on in Gilgit and the Frontier borders, but no longer in Kashmir.

Last stream on our fishing itinerary was the Kokernag and we drove to the Kokernag Valley some twenty-five miles from the Liddar, in the golden light of late afternoon. The road, which I remembered from my former trip as a trail of the most primitive sort, had been made into a first class gravel highway with stone and solid timber bridges. Quite aside from other considerations there is no question but that the occupation of the Vale of Kashmir by the Indian Army has resulted in a vast improvement in transportation. I understand this is true also of Pakistan occupied Gilgit and Baluchistan.

In contrast to the open, almost treeless, plain of the Liddar Valley where we camped for the previous three nights, our tents on the Kokernag were pitched in a grove of willows and sheltered from the winds by protecting hills on all sides. Allemere, the watcher, and Kadra, the shikari, arrived soon afterwards and assured me that their stream while not ' special ' like the Nambal and Tricker, did have good fish and they would show them to me. Like the Verinag, the Kokernag is a spring-born stream and is famous for the purity and mineral content of its waters. Tasting it, I found this boast to be quite true ; the water was delicious. There are very few places East of Suez where one would dream of drinking out of a stream.

The Kokernag was the best ' public ' stream I fished. It is not only beautiful scenically, but held plenty of fish. They are not large ; my best being only two pounds and the average about a pound, but I caught five in an hour during the first evening, eight the following morning, and six my last evening. I used a green Highlander lure and a March Brown on the dropper. The beat I had rented, the lower Kokernag, was two miles long and included many good pools and only a hundred yards or so of 'village fishing'. Most Kashmir trout streams flow at times through villages and trout were especially plentiful in these stretches; perhaps because the watchers could keep a better eye on them there and perhaps because of the constant washing of clothes, there was more for the trout to eat. I invariably returned these village trout.

All of the trout recorded in this account were browns except one, a rainbow, which I caught on the Verinag. All three of the hatcheries—the two outside of Srinagar and that at Achibal—breed rainbows as well as browns. I was particularly impressed with the Achibal hatchery. Situated as a kind of annexe to a Moghul garden, the trout enjoyed the same fresh spring water as the flowers, and the same keeper, who showed us the pansies, showed us the trout pens. He fed the fish on dried silkworms; a diet they seemed to thrive on. The browns I caught were all in the pink of condition and without exception put up fine battles. The stomachs of several browns, which I personally examined, showed they had fed on frogs, fresh water cray-fish, little trout and other small fish.

At various times I tried American and British standard wet flies with very little success. One or two of my Scotch salmon flies were effective but nothing duplicated the killing power of the Peacock, Golden Lion and Green Highlander lures. Dropper flies I found superfluous and caught only about ten per cent of my total on them. On most streams the fish are big and the water is fast so that strong leaders are necessary. I broke four 2-X and three 1-X leaders and certainly would not attack any Kashmir trout on leaders of less strength. On several occasions in the evening, when there was no wind, I tried dry flies and did induce a few small trout to rise to them. I understand that it is only in September that they are really effective.

The fishing on the public waters in Kashmir did not seem to me to be exceptional. Streams like the Lower Sindh, the Kurtsu, and the Kokernag provided good fishing, but it was really no better than the fishing on good public streams in America and Canada. I did not, however, fish the two best public streams—the Bringhi and Upper Sindh—which are said by old timers in Kashmir to provide some really spectacular sport, especially in the Fall months. The reserved streams, of course, rank with the best in the world.

Some of the rest-houses are quite good, but none have the charm of tenting. With canvas you are free to choose the location of your home and in Kashmir you can find some supremely beautiful camp sites. As I have often mentioned in this account, good and industrious servants are a blessing on a fishing trek. All of our three boys doubled in brass. The chauffeur helped pitch the tents, carried water for the cook and acted as an auxiliary butler, bringing the food from the cook tent to a serving table when it was ready to be served by Momdu. Momdu, himself, not only butlered but often went along with Rene as fishing shikari and every evening gave my weary frame a strong massage. The cook gave us really first class meals with three course lunches and four course dinners. He made savory curries, delicious desserts, and was able to serve trout in five different ways.

We went to Kashmir in May and even though the days were bright and warm, the nights were very cold. We slept under three blankets and wore flannel pyjamas. Baths—wonderful affairs in a tin tub—were taken at high noon. The girls wore blue jeans and sweaters and I wore wool shirts. Good heavy coats were necessary in the evening. The streams are freezing and unless one likes to wade in ice water I strongly advise fishing in waders. Sun glasses are also useful as there is a lot of glare on the stream at an elevation of over a mile. Whisky is obtainable in Kashmir only at an exorbitant rate so bring it with you from India.

TROUT CAUGHT IN KASHMIR

| Date | Stream | No. caught | Total weight | Best fish |
|---|---|---|---|---|
| May 13 ... | Verinag (No. 1 beat) | 11 | 24½ lb | 3½ lb |
| May 14 ... | Verinag (No. 2 beat) | 20 | 37 lb | 2½ lb |
| May 15 ... | Tricker (No. 5 and 6 beats) | 7 | 18½ lb | 4 lb |
| May 15 ... | Liddar (No. 5 beat) | 3 | 9½ lb | 5½ lb |
| May 18 ... | Sindh Lower | 7 | 4½ lb | 2 lb |
| May 20 ... (Morning) | Liddar | 5 | 12 lb | 6 lb |
| May 20 ... (Afternoon) | Big Nambal | 10 | 17 lb | 2¾ lb |
| May 21 ... (Morning) | Little Nambal | 12 | 25 lb | 3 lb |
| May 21 ... (Afternoon) | Liddar | 6 | 27½ lb | 5 lb |
| May 22 ... (Morning) | Kirtsu | 6 | 5½ lb | 2 lb |
| May 22 ... (Evening) | Kokernag | 5 | 6½ lb | 1½ lb |
| May 23 ... (Morning) | Kokernag | 8 | 12½ lb | 2 lb |
| May 23 ... (Evening) | Kokernag | 5 | 6½ lb | 1½ lb |
| | Total ... | 105 | 256½ lb | |

Only the fish we wanted for eating were kept. *All others were returned.* Limits on streams range from four to six fish per day, far more than a party of three can consume, especially as the average is better than two pounds.

The taking of trout tonnages, however, is to my mind only a part of the fun of fishing in the Himalayas. There is the camping, the beauty of the scenery and the sense of space. The mountains of Kashmir are the 'roof of the world' and as Kipling so aptly said 'he who has smelt the snows will return to them to die.'

COLOMBO,
*June* 6, 1955.

# GAME PRESERVATION IN KASHMIR

## Report and Recommendations of the Bombay Natural History Society's Delegation
## October 1952[1]

BY

R. C. Morris and Sálim Ali

### Introduction

The Director-General of Shikar and Tourism in Kashmir having requested the Bombay Natural History Society to make certain recommendations for the protection and preservation of game animals, in particular the Kashmir Stag or Barasingh (*Cervus hanglu*), we arrived in Srinagar on the 17th and 18th October 1952 for this purpose. Between the 19th and 28th October visits were made to the sanctuary of Lower Dachigam (between 6 & 7000 ft. elevation) and other Rakhs or Reserves, and to Gratnar (9800 ft.) in the sanctuary of Upper Dachigam.

The visits to Lower Dachigam gave us opportunities to see not only this important sanctuary for the Kashmir Barasingh, which come down to these lower altitudes in the late autumn and winter, but also some of these grand creatures themselves. Two stags were seen, with good heads of about 38″ and 42″, the latter with a number of hinds, We also saw Black Bear, including a pair, and a bear with 2 cubs. It is obvious from tracks and droppings that Black Bear are in abundance in this area.

It is the policy of the Game Department that the Dachigam Sanctuary, Upper and Lower, should serve as a stock breeding ground for Barasingh, forming the main pool from which these animals find their way to other connected Rakhs or Reserves. We consider this a wise policy, but under the circumstances we strongly feel that the Dachigam Sanctuary is under-staffed and that the present staff is not adequate to prevent poaching.

### Some of the apparent causes of poaching

(1) Considerable increase of guns.

(2) Decrease in game protection staff and low salaries of subordinate staff.

(3) Food shortage, hitherto, and high cost of mutton ; the demand for venison thus bringing in considerable profit to poachers.

(4) Withdrawal of magisterial powers of Game Wardens and difficulty in securing adequate punishment of poachers in the ordinary lawcourts.

With the advent of a democratic form of Government a large number of gun licences were issued for the protection of crops etc. There was a period of lawlessness prior to this, and the tribal raid occurred subsequently. It is estimated that very considerable poaching of the Barasingh occurred during these periods and their numbers were greatly diminished.

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[1] This report was originally not intended for publication but, though belated, it is now considered desirable to put it on record. In spite of enquiries, the Society has no official information whether any of the recommendations of its representatives have been given effect to.—Eds.

From figures supplied to us it would appear that the Game Watchers and the Jemadars are inadequately paid. They cannot live on the salaries they receive, and the result cannot but be an indirect encouragement to poaching. Once a subordinate finds that only by corruption can he obtain the means of livelihood, corruption will become a second nature to him and he will encourage rather than try to stop poaching. For comparison it may be pointed out that the Game Watchers in the Ceylon Game Department earn Rs. 45 to Rs. 65 per month ; and in the Mysore State Rs. 45 to Rs. 60, including dearness allowance. Game Supervisors in Mysore, who may be said to be the equivalent to the Kashmir Game Jemadars, get up to Rs. 85 p.m. ; and in Ceylon 'Game Guards', of a similar status, receive up to Rs. 86 p.m. The Dachigam Sanctuary is a long and large area, and however conscientiously the present staff might patrol it, their numbers are, we consider, quite inadequate for efficient results.

For the efficient administration of the Game laws and centralised supervision, we consider that the Rakhs or Game Reserves now under the administration of three Departments (Game, Tawaza, and Forest) should be amalgamated under a single Department.

At present it would appear that the GAME DEPARTMENT controls the following :—

1. Ovra.
2. Khiram.
3. Dachigam.
4. Half of Khunmuh (Chukor).
5. Cheshme-Shahi.
6. Bren (Chukor).
7. Kishat (Chukor).
8. Dara (Chukor).
9. Mirgund (Duck).
10. Hygam (Duck).
11. Shalabug (Snipe).
12. Pampur (Duck).

The TAWAZA DEPARTMENT appears to control :—

1. Khrew and Khrewshar.
2. Khunmuh.
3. Tral.
4. Aripal.
5. Hokra (Duck).

The FOREST DEPARTMENT controls the following :—

1. Achibal.
2. Razpariyni.
3. Ajas.
4. Chatragul.
5. Wangat.
6. Kazinag.

Although at present the Director-General of Shikar and Tourism is the head of both the Game and Tawaza Departments, it is considered that the whole could be more efficiently administered if brought under a single unified executive control with the staff of each receiving the same terms of pay and pensions. We are informed that the Watchers of the Tawaza Department receive pensions on retirement, but not those of the Game Department. This is, we feel, an additional encouragement to corruption in respect of Watchers of the latter department. Unless the Rakhs now under the control of the Forest Department are commercially essential to that Department for timber or other forest produce, we consider that in the interests of effective fauna preservation they should be transferred to the unified control of the Game Department.

## BLACK BEARS

From all accounts Black Bear have increased very considerably in the last few years and are rightly regarded as a pest. It would appear that quite a number were shot in the past by villagers with crop-protection guns and by holders of Rs. 15 Black Bear licences, thus securing the reward paid for Black Bear by Government. It is probably correct to assume, we consider, that with the high prices now secured for venison, slackening of the enforcement of the Game laws, and insufficient staff, those who previously shot Black Bear for the government reward and/or its pelt have now swelled the ranks of the poachers and concentrate on slaughtering the Barasingh. This would account for the present increase in the number of Black Bear, which, in turn, are known to prey on the fawns of Barasingh.

Lower Dachigam *stinks* of Black Bear, and their droppings and tracks cover the whole area.

The following Rakhs were visited in company with a member of the Director-General of Tourism's staff:

Ovra; Khiram; Khunmuh and Khrew-Khrewshar; and also some exclusively small game reserves, e.g. Hokra, Shalabug.

As in other parts of India, it appears that difficulty is experienced in getting poachers convicted in the ordinary Criminal Courts or, if convicted, in getting adequate sentences imposed. For example, a poacher with a licensed crop-protection gun may be fined a sum for killing a Barasingh which is considerably less than the amount realised by the sale of its flesh and hide; nor is the gun confiscated. Thus the punishment is no deterrent to the poacher. Many others, even with unlicensed guns, are acquitted, the offenders denying their guilt and the court demanding independent eye-witnesses whom the Game Department cannot produce. Enforcement of the Game laws thus becomes not only difficult but a farce. The *only* curbs to poaching, as has been proved elsewhere, are:

(i) A well-paid subordinate staff of an adequate strength.

(ii) Proper enforcement of the Game laws by a co-operative judiciary prepared to inflict deterrent sentences on offenders. Or preferably the Game Warden should be vested with the power to compound offences and to confiscate the guns of offenders, and generally placed in a position to inflict deterrent punishment.

## CONCLUSIONS AND RECOMMENDATIONS

(1) It is our opinion that Black Bear should be declared vermin for a period of 5 years initially and subject to review thereafter, and the reward for the destruction of the same should be increased to Rs. 15, payable to both sportsmen or others.

(2) We would further make the following recommendations :

(*a*) Crop-protection guns should be withdrawn from the licensees during the bear hibernation period (December to March) when the Barasingh descends to lower elevations and is vulnerable to poaching.

(*b*) Guns should be issued to Jemadars and Head Watchers to ensure efficient patrolling of their areas and to enable them to destroy Black Bears and other vermin. The number of Black Bear is so great now that the subordinate staff cannot be expected to patrol their areas properly if unarmed. In any patrolling they now do they are likely to declare their position and approach to poachers by talking loudly to scare away bears and so also disturbing the other game. If single-handed and unarmed, the patrols cannot reasonably be expected to tackle armed poachers without help within call.

(*c*) Licensees should have the power to arrest poachers and to hand the latters' gun over to the Game Warden, as in South India.

(*d*) The penalty for poaching should be increased to Rs. 300, since the present maximum penalty of Rs. 100 is considerably less than the value of a dead Barasingh.

(*e*) Suitable and keen persons should be appointed Honorary Game Wardens to assist the Game Department.

(*f*) Licensees should be asked to report the existence of machans or hides over salt-licks and paths to salt-licks and water.

(*g*) The number of Game Watchers in Dachigam (Upper and Lower) should be increased to 18 or 20 (from the present 11), including a separate Head Watcher at Gratnar.

(*h*) The total emoluments of both Game Watchers and Jemadars should be brought into line with those of South India and Ceylon, and the Watchers of the Game Department should also be entitled to pensions on retirement, same as in the Tawaza Department.

(*i*) The Game and Tawaza Departments should be amalgamated forthwith, and if possible the Game Rakhs now controlled by the Forest Department transferred to their unified control.

(*j*) The credentials and antecedents of those applicants for Big Game Shooting Licences who reside in the State and who are not well-known to the authorities should be carefully scrutinized before such applications are granted.

(3) It is suggested

(*a*) That for the sake of precision the scientific names of species listed in the schedules of the Game Preservation Act should be noted against the English names.

(*b*) That the gate leading into the Lower Dachigam Sanctuary should be repaired and that it should be kept padlocked at night.

(*c*) That licences for trout and other fishing in the Dachigam and other Rakhs be not withheld from sportsmen, since fishing does not cause any disturbance to game animals and the presence of sportsmen within the sanctuaries and reserves will act as a deterrent to poachers of Barasingh and other game.

(4) The Director-General of Tourism and Shikar had asked for clarification on the source of supply of the Kashmir wool known as 'Shahtoshah'. All the data we have procured indicate that although the soft undercoat of the Ibex, Tibetan Āntelope and Tibetan Gazelle forms (or did in the past) a part of the supply, this wool is for the most part obtained from the Tibetan Goat and imported into Kashmir from across its northern frontier.

(5) Finally, we were also asked to advise on the question of importing other species of animals which would be likely to thrive in Kashmir—the Elk and Red Deer being mentioned. We do not consider this to be a wise course. From experience of the consequences of importations of foreign animal species in other parts of the world, we feel that it would not be advisable to adopt such measures, at any rate in the present state of our knowledge concerning their ecology etc.

# BIOLOGY AND ECOLOGY OF ORIENTAL TERMITES (ISOPTERA)

## No. 3. Some Observations on *Neotermes gardneri* (Snyder) [Family Kalotermitidae]

BY

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(*With a text-figure and 2 plates*)

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## I. Introduction

The large and primitive termites belonging to the family Kalotermitidae often bore into dry wood and rotten wood in standing trees, houses etc., and cause considerable damage. The galleries are large and go deep into the wood, not excluding the heartwood, and look like the galleries of beetle borers but are distinguishable from the latter by the fact that portions of the irregular galleries are filled with brownish masses made up of the small, semi-cylindrical and rugose excretory pellets cemented together by salivary or other secretions into irregular masses. Sometimes, as in the dry wood form, *Cryptotermes* spp., the loose pellets may lie outside the bored part of the wood.

Only a few species of *Neotermes* are known to attack living trees, the rest attacking dead or rotten wood. Among the former are the following: *Neotermes tectonae* (Damm.) of Java bores living teak trees (*Tectona grandis*) in Java and is a serious pest, causing swelling and canker formation on the trunk; it occurs on several other hosts also (Dammerman, 1915 and Kalshoven, 1930). *Neotermes greeni* (Desn.), *N. militaris* (Desn.) and *N. militaris* var. *unidentatus* (Kem.) of Ceylon bore the heartwood and even roots of the tea plant, *Camellia sinensis* (Linn.) O. Kuntze, eating the plant hollow and ultimately killing it. (*vide* Pinto, 1941, pp. 80–81).

Sometime ago we found the Indian species, *Neotermes gardneri* (Snyder), which has already been recorded as boring dead, rotten branches of mango, *vide* Snyder 1933; Beeson, 1941 boring *living* portions of trees in Dehra Dun (U.P., *ca.* 2,000 ft.) in addition to the dead ones. As nothing is known of the biology and ecology of the species, some observations made on the nature of damage, the season of the emergence of alates etc., are described here; records in the ledger files pertaining to the earlier collections are also summarised.

## II. OBSERVATIONS

### 1. Host-plants (Table 1)

The five host-plants so far recorded, all at Dehra Dun (U.P.), are mentioned briefly in Table 1, and fuller details are given below:

TABLE 1—HOST-PLANTS OF *Neotermes gardneri* (SNYDER)

| Botanical name and Family | English name | Vernacular name (Hindi etc.) | Locality | Remarks |
|---|---|---|---|---|
| 1. *Artocarpus lakoocha* Roxb. (Fam. Urticaceae). | — | Barhāl; dehū. | Dehra Dun (Western Himalayas, U.P.), *ca.* 2,000 ft. | In dead wood. |
| 2. *Litsaea polyantha* Juss. (syn. *Tetranthera monopetala* Roxb.) (Fam. Lauraceae). | — | Karkāwa; Singram | ,, | In rotten log. |
| 3. *Mangifera indica* Linn. (Fam. Anacardiaceae.) | Mango. | Ám. | ,, | In dead branches. |
| 4. *Pterospermum acerifolium* Willd. (Fam. Sterculiaceae). | — | Kanak-champá; mayeng. | ,, | In both dead wood and adjoining *living* wood in thick (24-inch girth) branches. |
| 5. *Woodfordia fruticosa* (L.) Kurz. (syn. *W. floribunda* Salisb.) (Fam. Lythraceae). | — | Dhaulā | ,, | In dead trunk of fallen tree, at *ca.* 18-inch girth. |

The initial specimens (alates and nymphs) from which Snyder (1933, p. 4) described the species, were collected in April, 1931, in Dehra Dun (U.P.) from a rotten branch of mango, *Mangifera indica* Linn., about 12 feet from the ground. More specimens (soldiers, alates and nymphs) were collected from mango trunk in Dehra Dun on 4th July, 1932, when a field note was recorded that 'the main trunk of tree was apparently healthy'. Again, specimens (including the queen, some soldiers and several nymphs) were obtained from the same place on 19th April, 1953, inside the wood of a half dried branch of living mango tree. On 4 February 1940, some soldiers and nymphs were obtained from galleries in a rotten log of *Litsaea polyantha* Juss. in New Forest, Dehra Dun. On 3rd March, 1940, a soldier and some nymphs were obtained from a dead log of *Artocarpus lakoocha* Roxb. in Dehra Dun, and later on (no date recorded) some alates were obtained from the same source. On 26 February 1954, in New Forest, Dehra Dun, a dead branch of a large healthy tree (height 100 ft.; girth at 4½ ft., 15 in.) of *Pterospermum acerifolium* Willd. was found heavily bored by the species, several soldiers, alates and nymphs being collected. The infested branch was about 2 ft. in girth; when cut it was found that the healthy, *living* portion of the branch adjoining the dead portion was also attacked by the termite; the tree did not show any sign of weakness. Again in New Forest, Dehra Dun, on 27 January 1955, a one-foot girth main trunk of a fallen, dead tree of *Woodfordia fruticosa* (L.) Kurz (syn. *W. floribunda* Salisb.) was found attacked, at about 2 feet from the ground, and some soldiers, alates and nymphs were obtained.

## 2. Nature of Damage (Pls. 1 and 2)

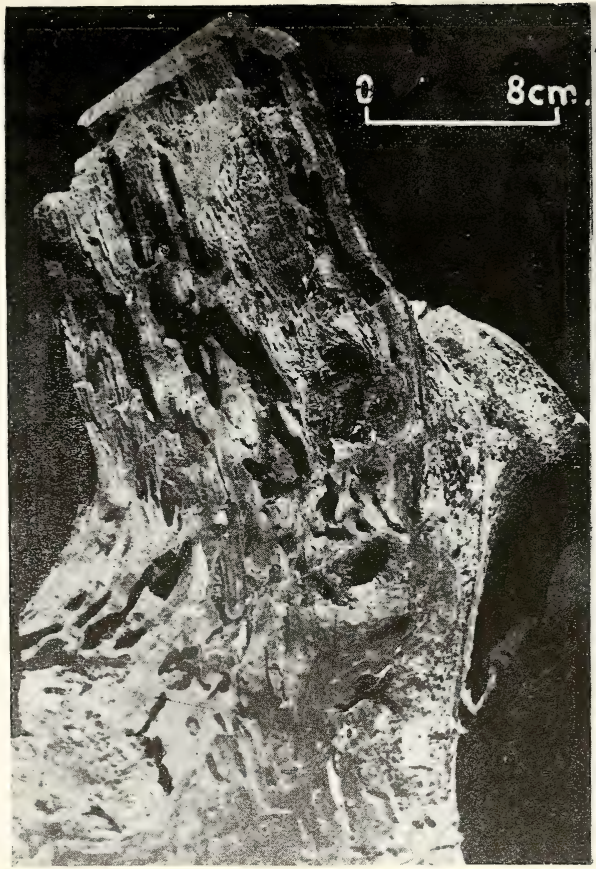
As stated above, while generally dead or half-rotten wood is attacked, when this portion adjoins the healthy living portion of the branch or trunk the attack passes into the healthy portion also. No death of host trees has so far been reported. In the laboratory a part of the bark of *Pterospermum acerifolium* branch was also eaten up.

The termite makes an irregular network of large interconnected, flattened galleries which lie mostly in the centre (i.e. in the heartwood in some species), leaving the peripheral sapwood comparatively unaffected. In a *Pterospermum* piece the network consisted of flattened galleries of diameters in cross-section about 30 mm. or over × 2–4 mm. (Pl. 2, figs. 1 and 2); sometimes, larger excavations are made.

## 3. Faecal Pellets

(Pl. 1, fig. 6; and text-fig.)

The galleries are usually filled with brownish masses composed of the tiny pellets of excreta cemented together, along with a little wood dust, probably with the aid of the salivary secretion. These masses are bored through with a few small galleries for the passage of termites and can be easily crumbled to a powdery, granular mass if gently rubbed between the fingers and the thumb. The masses are sometimes as large as 3×4·5 cm. in size, the actual size depending upon the dimensions of the gallery or cavity in which they are lodged.



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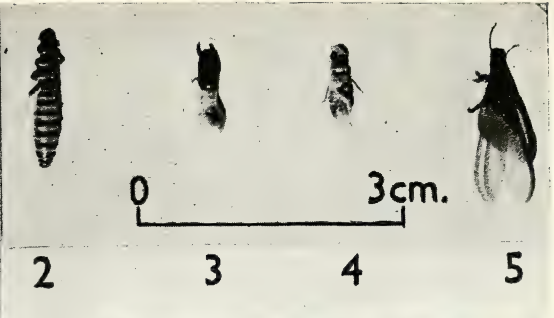

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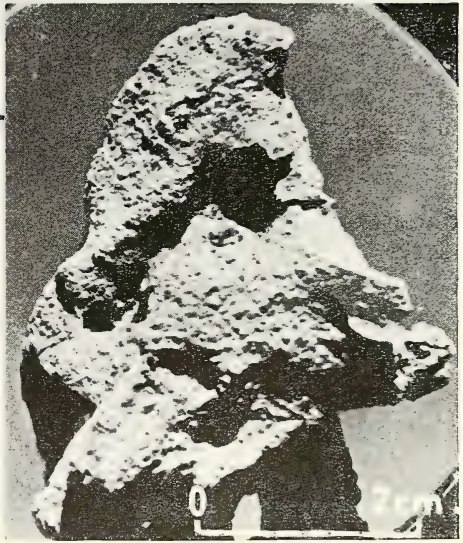
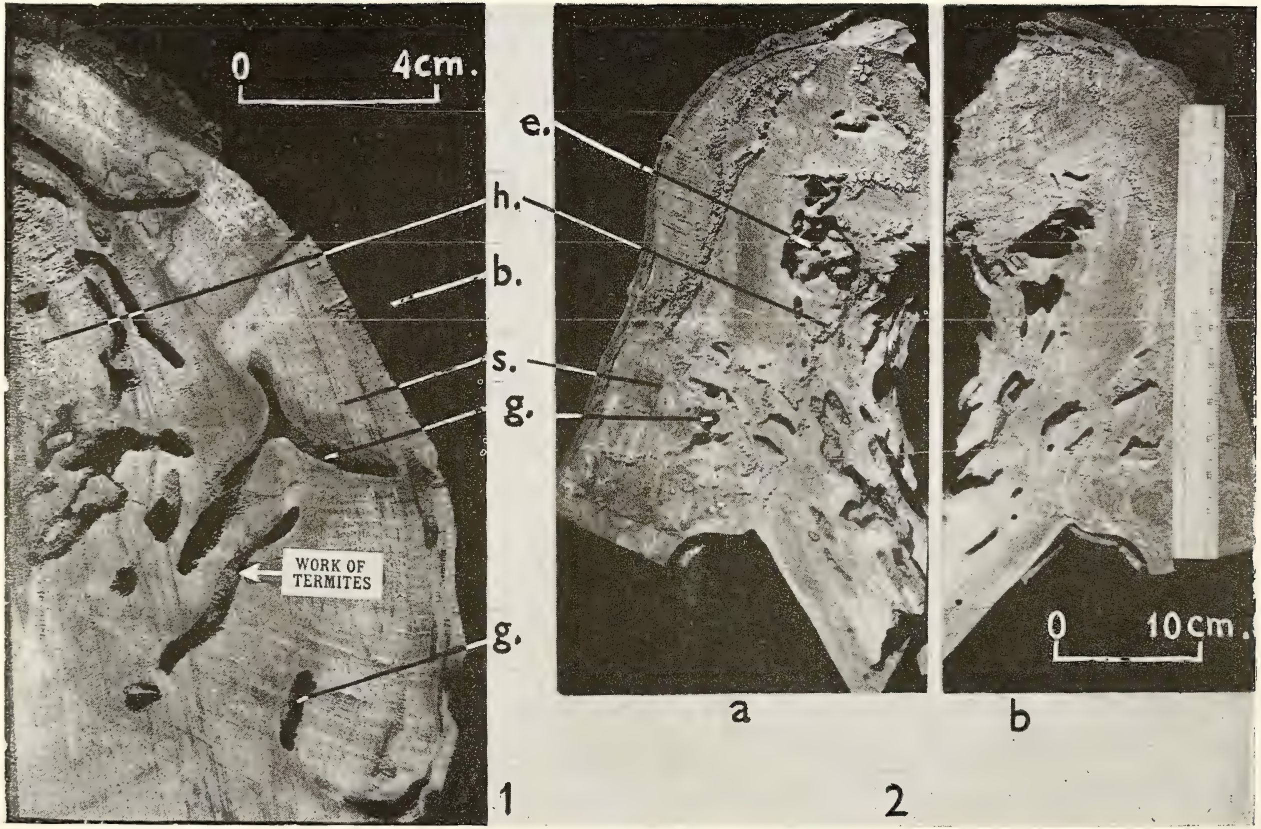


FIG. 1. Surface view of a branch of *Pterospermum acerifolium* Willd. attacked by *Neotermes gardneri* (Snyder).

FIGS. 2–5. Various castes of *Neotermes gardneri* (Synder). (2) Queen. (3) Soldier. (4) Nymph. (5) Alate.

FIG. 6. A disintegrated faecal mass of *Neotermes gardneri* (Snyder) taken from a wood-cavity in a branch of *Pterospermum acerifolium* Willd.

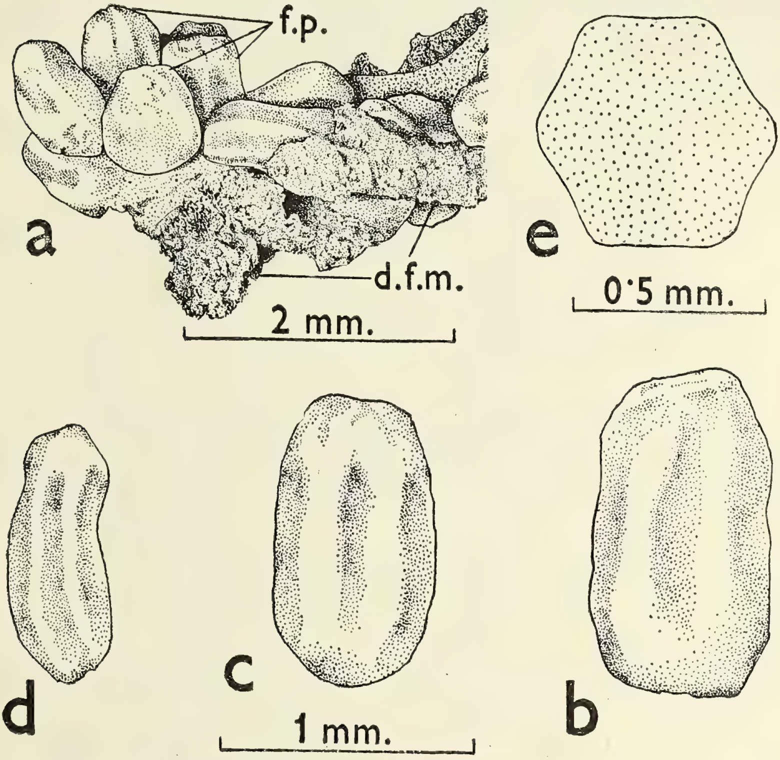

0 4cm.
e.
h.
b.
s.
g.
WORK OF TERMITES
g.
a
b
0 10cm.
1
2

Lettering : *b.* bark ; *e.* mass of faecal pellets ; *g.* termite galleries ; *h.* heartwood (?) ; *s.* sapwood.

FIG. 1. Transverse section of a branch of *Pterospermum acerifolium* Willd., showing galleries of *Neotermes gardneri* (Snyder).

FIG. 2 (*a*, *b*). Ditto, in longitudinal sections.

It is probable that these masses, being hygroscopic, function as reservoirs of moisture and thus serve to condition the humidity inside the galleries.



Text-fig. 1. Faecal pellets of *Neotermes gardneri* (Snyder). The pellets form masses which fill the cavities in wood made by the termite.

(*a*) A mass of faecal pellets cemented together. Note that some pellets have not completely disintegrated but have retained the original form. (*b*)–(*d*) Surface views of three faecal pellets. (*e*) Transverse section of a faecal pellet.

*d. f. m.* disintegrated faecal mass ; *f. p.* faecal pellets adhering to each other.

The faecal pellets are tiny, reddish brown and sub-cylindrical and with 6 weak but distinct longitudinal ridges on the surface, giving a distinctly hexagonal appearance in cross section. The size of individual pellets varies considerably— length *ca.* 0·9–1·14 mm. ; diameter *ca.* 0·5–0·7 mm.

## 4. Castes so far known

(Pl. 1, figs. 2–5)

The castes so far recorded are : soldiers, alates (fully-winged males and females, and queen), and nymphs. As in the other Kalotermitidae, the worker caste is wanting, the function of workers being performed by the older nymphs.

### 5. Emergence of Alates in Laboratory and Field

Infected wood pieces were caged in the laboratory and the following records of emergences obtained:

(i) A mango branch (*Mangifera indica*) was caged in a room in New Forest, Dehra Dun, on 19th March, 1931 (Forest Entomologist's files), and the following emergences occurred, none occurring after 15th May:

| *Date* | *Alates emerged* |
|---|---|
| 9th April | 5 |
| 10th ,, | 1 |
| 13th ,, | 3 |
| 17th ,, | 2 |
| 20th ,, | 2 |
| 26th ,, | 3 |
| 2nd May | 13 (41%) |
| 7th ,, | 1 |
| 11th ,, | 1 |
| 15th ,, | 1 |
| | 32 |

(ii) An infected piece of the trunk of *Pterospermum acerifolium* similarly caged on 26th February, 1954, gave the following emergences; none occurred after 8th June although the cage was kept under observation up to 17th September:

| *Date* | *Alates emerged* | |
|---|---|---|
| 11th May | 1 | |
| 14th ,, | 3 | |
| 25th ,, | 1 | |
| 27th ,, | 3 | |
| 31st ,, | 10 | (48%) |
| 1st June | 12 | |
| 2nd ,, | 8 | |
| 5th ,, | 4 | |
| 8th ,, | 4 | |
| | 46 | |

In addition, alates were collected in the field on the following dates: 26th February, 19th April and the 4th July.

From the above data it would appear that at Dehra Dun the alates emerge from the last week of February to the first week of July more or less continuously. In the 1931 rearing 41 per cent emerged on the 2nd May, while in the 1954 rearing 48 per cent emerged on two days, 31st May and 1st June. This feature is in contrast to the higher termites, e.g., *Odontotermes* spp., where virtually all emergences of alates usually occur *en masse* during a short period of a few days at certain stated seasons, once or twice a year, and almost none at other times.

## III—SUMMARY

1. *Neotermes gardneri* (Snyder) has been recorded as boring into the heartwood and sapwood of the following 5 species of trees: *Artocarpus lakoocha* Roxb., *Litsaea polyantha* Juss., *Mangifera indica* Linn., *Pterospermum acerifolium* Willd. and *Woodfordia fruticosa* (L.) Kurz. (syn. *W. floribunda* Salisb.) in Dehra Dun (U.P., *ca.* 2,000 ft.).

2. Generally dead wood is attacked, but where this adjoins living, healthy wood, the attack spreads to the latter. No death of hosts have so far been reported.

3. It makes a network of large irregular galleries, preferring the heartwood, though the sapwood is not altogether avoided. The galleries are filled with reddish brown lumps of matter composed largely of the excretory pellets cemented together.

4. Each excretory pellet is tiny, reddish brown, and sub-cylindrical, and is ridged longitudinally with 6 ridges. Length *ca.* 0·9–1·14 mm.; diameter *ca.* 0·5–0·7 mm.

5. The castes so far known are: soldiers and alates (♂, ♀, queen). Workers are absent.

6. The emergence of alates occurs from the last week of February to the first week of July, mostly from early May to early June.

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# REVIEWS

## 1. SAMPON KI DUNIYA (in Hindi). By Ramesh Bedi. Pp. 330 (4″ × 6½″), 13 photographs, 3 text-figures and 6 line drawings. Vidnyan Parishad, Prayag (U.P.), 1951. Price Rs. 5.

'Sampon Ki Duniya' (Serpent World) is interesting to a layman, as well as to a specialist. The author, a naturalist himself, is particularly familiar with snakes and their habits. He has recorded in this small work his personal observations, giving a fund of scientific and otherwise interesting information collected from different sources.

The book deals with many aspects of serpent-life with copious references about snakes in Indian mythology and the ancient Sanskrit literature. The noteworthy feature of the publication is the right perspective in which the author has presented the information. He states clearly that the so-called antidotes to snake poisons referred to in the Ayurvedic literature, and the ones claimed by many persons, have not stood the test at the Haffkine Institute, Bombay, although over three thousand such medicines were tried.

There are 21 chapters in all; the first few describe some common snakes, and the rest deal with general information about snakes, their classification, identification of poisonous snakes, the poison apparatus consisting of the poison gland and fang etc., snakes used as food and freaks in snakes.

In the last few chapters the author has described the role of snakes in nature, and in conclusion has justly appealed for the protection of snakes, mentioning many instances where harmless snakes have been slaughtered in large numbers.

M. R. R.

## 2. BIRDS OF SAURASHTRA, INDIA. By R. S. Dharmakumarsinhji, F.Z.S., M.B.O.U. Pp. liii+561 (11¼″×8″). 34 coloured and 18 photographic plates, 16 maps. Published by the author, Bombay 1955. Price Rs. 50.

Here is a sumptuous volume truly reminiscent of the vanished pomps of yesterday. The author, a younger brother of the Maharaja of Bhavnagar, is a seasoned ornithologist and the book is proof of the good use he has made of his exceptional opportunities to study the bird life of Saurashtra in its native setting. His keen interest in falcons and falconry, and in game breeding and wild life preservation, and his competence in bird photography have all contributed to the value of the work.

Saurashtra is a particularly interesting area for the bird student since it lies on the migration route of a large number of European and north Asiatic birds which winter in India or pass through on their way to Africa.

It is unfortunate that when writing up his notes the author did not have the benefit of reference to Sálim Ali's comprehensive report on the Birds of Gujarat, which appeared whilst the book was in the press. Thus, a large number of common species, presumably not collected by the author, remain unnamed racially in the book, while there is nothing to indicate on what material many of the other races have been determined by him.

In a supplement, which covers a considerable portion of the book, birds which have been recorded from Gujarat and/or Kutch but not yet from Saurashtra are listed and described. This portion of the work is of necessity incomplete, and suffers particularly from lack of reference to the Gujarat bird paper.

Statements sprinkled here and there in the body of the work are not always very clear or convincing. For instance, it is said that *Charadrius hiaticula* was also recorded (presumably at Jamnagar). Why then has this not been listed ? *Numenius arquata arquata* is said to be a migrant to India and Ceylon, but we are not aware of any definite identification of this race south of Sind. It is stated that the Purple Sunbird 'can fly backwards. The tremendous speed of the wing-beat at times reaching 200 per second . . .' This reads exceedingly like the description of some humming bird, the only bird capable of this feat by virtue of its rather differently constructed wing. And the estimate of the stroke-frequency is surely conjectural, and surely much exaggerated. One of the smallest humming birds, namely *Phaetornis rufus*, with a wing length of about 36 mm. (as against the sunbird's 55), which perhaps also has the fastest wing beats among birds, has been proved, with the aid of the stroboscope, to have only 50–51 beats per second. As far as we are aware the Housefly has the fastest ascertained wing beats, namely about 200 per second.

The reviewer has been quoted for a method of distinguishing the Pintail from Fantail Snipe in flight, but the diagnostic characteristics of the two species have unfortunately been reversed !

Among the many observations recorded which are original, and sometimes surprising, are that Green Pigeons feed also by moonlight; that the call of Franklin's Nightjar is reminiscent of that of the Rufousbacked Shrike; that the female Blacknaped Flycatcher resembles the Whitebellied Drongo; that a male Blackheaded Cuckoo Shrike can be confused with a male Magpie Robin at a distance; that Mahratta Woodpeckers are so intelligent that they 'will nest in other kind of trees if [they find] a particular species is being felled in an area'. The Common Iora (*Ae. t. tiphia*) and the Central Indian Iora (*Ae. t. humei*) are both recorded, the latter as confined to Gir Forest and Girnar 'where it is common and resident'. One would like to know if this statement is based on specimens collected. Those obtained by the Gujarat Survey in the immediately adjoining areas of Kodinar and Amreli districts were certainly *humei*.

The practice of translating English names into Gujarati *literally* does not always produce happy results, particularly in the case of names associated with persons. Marshall's Iora as 'Marshall-no-Shobinga' or Pallas's Fishing Eagle as 'Pallas-no-Machhimar-Garud' have surely less to commend them than Gujarati names indicating something characteristic in the appearance of the birds, such as the white fringe in the tail of the former and the broad white band in the tail of the latter whence it gets its alternative English name of 'Ringtailed Fishing Eagle'. However, bird names in the local languages are essential and indispensable if the study of birds is to progress in the country, and the sooner they can be stabilized and put into currency the better.

The coloured illustrations, though they help to supplement the text as regards field identification, are unfortunately of the 'too artistic' type. Many of them, particularly of the Passerine birds, are stiff and unconvincing. The absence of a measurement scale on the plates is a serious omission, especially in cases where the size differences of the species depicted are great, e.g. on Plate 20—Peacock and Desert Lark. The bird photographs include some good examples of the work of the author, the Yuvraj of Jasdan and others, particularly interesting being those of the Great Indian Bustard and the Lesser Florican. All bird students in India are of course familiar with the excellent field studies of R. S. Dharmakumarsinhji on the breeding habits and migration of the latter species, published in the Society's *Journal*.

The 40-page supplement 'Some Notes on the Birds of Gujarat and Kutch', which follows the Saurashtra list, is succeeded by 5 Appendixes. One of these, which contains extracts from the Bombay Gazetteer, Gujarat States, relating to the physiography of Saurashtra, is of particular usefulness. Of much interest also is Appendix IV giving details of recoveries of florican ringed in Bhavnagar by the author some years ago. The significance and relevance of the 5th Appendix describing the Knot is not obvious, and not understood. A glossary of some local terms and abbreviations is given, and a species index completes the text.

This is a highly commendable contribution to the ornithology of a particularly fascinating area of the Indian Union. The author is to be felicitated upon the perseverance with which he has pursued a study which, despite an encouraging increase in recent years, still finds but few serious adherents in our country.

And lastly, great credit must go to the printers, the Times of India Press, Bombay, for demonstrating that really high class bookmaking *can* be done in India, comparable with the best anywhere in the world.

H. A.

3. AFRICAN HANDBOOK OF BIRDS, Series One: Birds of Eastern and Northeastern Africa, Vol. II. By C. W. Macworth-Praed. M.A., F.Z.S., M.B.O.U., and Capt. C. H. B. Grant, F.Z.S. M.B.O.U., Pp. viii + 1099 + 54 pp. index unnumbered (8½″ × 5½″) 42 coloured, and 13 plates from photographs; marginal distribution maps and drawings. London, 1955. Longmans, Green & Co. Ltd., Price 45*s*. net.

The main features of this excellent series were noticed in these pages when reviewing Vol. I (*JBNHS*, 51 (3): 709–711, August 1953), and need not be repeated here. This second volume deals with a further 825 species covering the remaining 22 passerine families, giving in concise, compressed form all that is known of their general and local distribution, habitat and habits, breeding, food and calls.

The reviewer is glad to find that two of the blemishes he drew attention to in the case of Volume I, namely absence of a list of coloured plates at the beginning and the use of unnecessarily elaborate vegetational backgrounds on the much-reduced plates at the sacrifice of space and clarity in printing, have been removed. All the coloured figures on the plates in this volume are printed on plain white ground. The figures thus not only stand out clearer, but it has been possible to include many more species on each plate (10 to 16 in many cases), thus enhancing the usefulness of the book. Unfortunately a measurement scale on the plates is still lacking, and the absence of a good physical map of Africa continues a major handicap in a work that has so much else to commend it.

The coloured plates in Volume II are chiefly the work of D. M. Reid-Henry and Miss C. E. Talbot Kelly with a few by N. C. K. Lighton. Those by Henry are of the usual high standard we have come to expect of this gifted artist. Miss Talbot Kelly is a comparative new comer to the field, and the reviewer feels that many of her drawings are excellent examples of modern scientific bird portraiture, deserving of the greatest commendation and encouragement.

The 13 plates of photographs of birds at the nest by Dr. V. G. L. Van Someren at the end of the volume, and the many black and white marginal drawings add much to the attractiveness of the book, as the marginal distribution maps do to its usefulness.

The authors in a prefatorial note apologize for the unavoidable size and weight of the volume, which is now indeed half an inch fatter and several ounces heavier than its plump predecessor! Considering, however, the very good value the two volumes together offer in covering all the 1500 odd species of birds found in the area in such a comparatively portable compass, no one will seriously grudge the slightly increased inconvenience in handling the present one.

The dust jacket announces that the 2 volumes of the Second Series of this Handbook by the same authors, covering the birds of the southern third of Africa, are now in an advanced state of preparation. Bird students will await their appearance with pleasurable anticipation.

S.A.

4. FLEAS, FLUKES AND CUCKOOS—A study of Bird Parasites. By Miriam Rothschild and Theresa Clay. Pp. 8½″ × 5¾″ With plates. Collins's The New Naturalist Series, London, 1952. *12s. 6d.*

With the increasing number of books that have been written on bird behaviour, we are now quite accustomed to think of the bird as an individual. Not so familiar is the idea of the bird as a community. Birds provide food, warmth and shelter to so many different organisms that Shipley exclaimed: 'They are not only birds but aviating zoological gardens.' This is an account of how the dwellers in this peculiar habitat feed, reproduce and cling tenaciously to life, and of their relations with each other and with their hosts.

The importance of the study of parasites need scarcely be stressed. Insects and ticks, to quote our authors, are the makers of history, the moulders of man's destiny, and one of the real enemies of the human race. Studying the parasites of other animals is often a short cut to knowing our own. For example ducks and gulls have in their veins a blood fluke with a life cycle like that of the human fluke, the cause of bilharzia, a serious disease in the Middle East. Had parasitologists known their bird parasites better, they would have found the study of the human fluke a great deal simpler than they did.

The book is divided into three parts. Part one deals with the kinds of relationships possible between different species, a proper understanding of which must form the basis of the study of any animal community.

In part two, each author discusses her particular branch of bird parasitology. Miss Rothschild is an authority on fleas, while Mallophaga or feather lice are Miss Clay's special field. The two groups form an interesting contrast to one another. Fleas are primarily nest dwellers and come on their hosts' bodies only to feed. They are therefore little affected by changes in their hosts, and only 14 species are found in Britain. Mallophaga, on the other hand, spend their whole lives among the feathers of their hosts and soon die when separated from them. So intimately are the two associated with each other that every change in the bird has brought about a parallel change in its lice. As a result about 1,500 species are known in Britain, and almost every group of birds has lice peculiar to it and found on no other. This makes it possible for an expert to tell what group a bird belongs to by a study of its Mallophaga, and parasitologists have helped to unravel many a knotty problem of bird systematics in this way. Flamingos have been variously included among ducks and geese or among storks and herons. They are parasitized by 3 genera of feather lice, *Anatoecus*, *Anaticola* and *Trinoton*, found only on ducks and geese. The most likely explanation is that flamingos are more closely related to this group than to storks and herons.

Part three is a general account of all other classes of bird parasites. It is a mine of interesting facts and scientific knowledge, and is written in a delightful style. We discover, among other things, that the male roundworm has 'a saucy curl to his tail,' and that the duck leech is an admirable parent carrying her 300 odd young attached to her underside. *Dermatobia*, a warble fly, has solved the transport problem in a better way; she finds a mosquito and attaches her eggs firmly to its abdomen. The young, when they hatch, slip on to the mosquito's next victim. Another ingenious insect uses a sort of Davis apparatus to escape from the bottom of the pond where it is born. As the time approaches, air accumulates in the pupal skin and on emergence the insect is carried upwards in the bubble 'without even getting its feet wet.'

As with other books of the New Naturalist series, the plates are excellent. It would, however, be easier to find them if, when they are referred to in the text, the number of the page opposite is mentioned. Apart from this the book is an admirable up-to-date popular account of a fascinating world which, until now, was known only to a few specialists. Many thanks are due to the authors for having thrown open the gates to a wider public and it is to be hoped that a great deal of active interest and research will be stimulated in a field where much remains to be done.

R.R.

### 5. BIRD NAVIGATION. By G. V. T. Matthews. Pp. (vii + 141). 33 text-figures. Cambridge University Press, 1955. Price 12*s* 6*d*.

In the last 5 years the experimental approach to the problem of bird navigation has made rapid strides. The author of this book, who has carried out so much of the important research, has done a further valuable service in summarizing, in a book of convenient length, the present state of knowledge on this central problem of bird migration.

In the first chapter Dr. Matthews shows what taxonomy, ringing and field observation have contributed to our understanding of the problem.

These techniques have shown that many long-distance migrations are a sort of shuttle service to and fro between more or less restricted breeding and winter quarters. The journey is frequently complicated by obstacles ; it may be on a broad front over featureless country or over the sea, or concentrated along narrow fronts by the now well-known 'leading lines' such as coastlines or escarpments. But for this kind of migration it seems generally sufficient that a bird should be able to fly in one or more fixed compass directions for a certain distance, compensating if necessary for displacements due to wind or physical obstacles. (Only for some species, such as the Great Shearwater, which nests only on the Tristan da Cunha group, spending the rest of the year scattered over the North and South Atlantic Oceans, it seems that simple bearing and distance navigation would not suffice.)

In Chapter 2 are reviewed the displacement experiments that have thrown more light on these bearing and distance migrations. Such experiments, which have been carried out on such birds as White Storks, Hooded Crows, Sparrowhawks and Starlings, have shown that young birds, migrating for the first time, do in fact fly innately in certain compass directions (for most European species, SW. in autumn and NE. in spring). If they are caught while on migration and transported to one side or the other of their route, they stay displaced, proceeding in their normal compass direction and taking up winter and breeding quarters to one side or the other of their normal quarters. (Unless carefully devised, these experiments tend to be complicated by the fact that some young birds, for example White Storks, will accompany older birds.) Old birds, caught on migration and transported away from their migration route, have been found to behave differently : a proportion of them regain their normal breeding and winter quarters. These experiments, then, have provided valuable information confirming and amplifying what can be found out from field observation alone. In brief, birds innately fly in certain compass directions for certain more or less fixed distances, but, once they have had experience of a breeding or a winter home, they learn some characteristic or characteristics of these homes which enable them to return to them from unusual directions, or in other words, to 'home' to them.

The author next goes on to examine the earlier homing experiments with pigeons and some other birds. The usual practice was to remove a bird from its home (often from its nest), take it away to a distance, release it, and see if it returned to its home, and if so how long it took. From all these early experiments it was possible, as little as six years ago, to doubt whether a true homing faculty really existed. For instance Dr. Wilkinson, a Cambridge mathematician, showed that, if certain not unreasonable assumptions were made, all the successes in these experiments could be accounted for on the hypothesis that the birds simply searched at random until they reached known country, and this method could also be used to explain the results obtained with old birds in the displacement experiments described above. It is interesting to note that the well-known sport of pigeon racing did not throw much light on the problem, and pigeon fliers usually train their birds from fixed directions, gradually increasing the distance from the loft, so that a simple ability to fly in a fixed compass direction, which we have seen that birds possess, coupled with the learning of landmarks, is sufficient to account for the high success obtained in pigeon races.

It was in 1951 that Dr. Matthews showed that pigeons possess a true homing ability—that is to say, if taken to unknown country, in a direction from which they have never previously returned home, they can find their way back in a much shorter time than would be required by a random search. Almost at the same time Dr. Kramer, a German biologist, independently obtained the same results; then a little later, Matthews showed that Manx Shearwaters also possess this ability. Matthews established the further important point, that his pigeons were orientated shortly after release. While still in sight, they were starting to fly in the home direction. This has since been amply confirmed, and observation of the direction in which the bird is lost to sight at the point of release has become the standard method for assessing orientation in homing experiments. It is in fact a rather more reliable, as well as quicker, indicator of homing ability, as a bird may start in the right direction but may not always arrive, owing to hazards on the way or even, if the bird is not well settled, to a disinclination to go back to the loft.

The remaining five chapters of the book are concerned with the possible methods by which homing may be achieved. The author first deals with experiments, largely carried out by Dr. Kramer and his colleagues, which have shown that migrants kept in cages, from which they can see the sky but no landmarks, are able to orientate themselves by the sun. By a number of ingenious experiments Kramer showed that they are able to allow for the movement of the sun through the sky. If, for instance, they have taken their direction from the sun and then, after a period in which the sun has been obscured, are shown an artificial sun in the same position, they take up a new direction differing from their previous direction by the amount that the sun should have moved in the interval. We can thus understand how, at least in fine weather, migrants can fly in fixed compass directions. This does not, of course, show how a bird might home from a strange direction in strange country, which is the central problem of homing, but it gives two clues—it suggests that, as the sun is important for one sort of navigation, it may also be for another, and it shows that, once the homing bird 'knows' (by whatever means) in which compass direction it should fly, it has the ability to do so.

At this point the author considers some theories of bird navigation that have been put forward in the past, but which now appear to be quite ruled out. These theories depend on the bird's ability to perceive various forces, magnetic or mechanical, whose value varies in different places. For the purpose of this review it need only be said that theoretical considerations and experimental evidence are now firmly against such ideas. It seems certain that the eye is the chief sense organ involved. Visual clues, coupled with the other faculties that birds are known to possess, must provide the data on which the homing faculty is based.

In the last two chapters Dr. Matthews expounds the theory which he himself has developed to account for homing. Before describing it, it is as well to go a little more fully into the facts that need to be explained —facts that have been established in a succession of experiments by Mathews, Kramer and others over the last four years. First, untrained pigeons can home successfully from unknown country; in good conditions they are well orientated before they are lost to sight. The ability does not depend on the birds' previous experience: even birds that have been kept all their lives in an aviary can home. Secondly, the sun must be visible : the more overcast it is at the point of release, the poorer the homeward orientation. Thirdly, there is evidence that orientation is not so good at short distances from home as it is at greater distances : at distances of 30 miles or less, the birds seem to find difficulty in orientating.

Now, seeing that the sight of the sun is important and the various ' unknown ' senses seem to be ruled out, Matthews suggests that the birds navigate by the sun in the way that, under the circumstances, we should be forced to navigate—the only way in which, given the sight of the sun for a minute or so, it is, as far as we know, possible to navigate. Matthews' hypothesis is this : During the time that the birds are kept at home, they learn the characteristics of the sun's path through the sky, in particular its height at noon, and their time sense (which is known to be highly developed) becomes ' geared to ' the sun's revolutions. This means that at any moment the bird will ' know ' at what height the sun should be, in which direction it is moving, and how far it is from the noon position. If the bird is now removed from its home, transported some distance away, and then released, it will be able, by watching the sun for long enough to judge its path through the sky, to find out in which direction its home lies. If the sun's path at the place of release indicates that its noon altitude is lower than at the home (these details are of course applicable only to the northern hemisphere outside the tropics), the bird has been displaced northwards, so must fly with the southerly component, and *vice versa*. If the sun's path indicates that it will reach the noon position later (as judged by the bird's internal time sense) than it would at home, then the bird has been displaced westwards, so must fly with an easterly component, and *vice versa*. Thus if the bird can judge accurately enough in this way its latitudinal and longitudinal displacement, it will be able to orientate itself towards home.

The author admits that his hypothesis is not proved yet, but there are a number of points in its favour. It depends on senses that are known to be especially well developed in birds. In particular, it is known that birds not only have acute vision but also are able to detect very small movements ; and it has been found that they hold their heads extraordinarily steady in flight, so that the inner ear, the organ of balance, could provide the ' artificial horizon ' necessary for accurate assessment of the sun's path. These are general points in favour ; there are also some special points in favour of the theory. The fact that orientation is not so good at short distances from home would be expected, as a small displacement in the sun's arc will be more difficult to detect than a large one. Then Matthews has found that his pigeons make the sort of mistakes that they would be expected to make on his hypothesis. For example, the proportion of gross errors in orientation was found to be highest in releases in early morning, when the sun was farthest from its noon position and the extrapolation of its course consequently most difficult. Further, he has experimented with means of disrupting the birds' time sense and resetting it to a false time, and he has reported that after this treatment pigeons tend to fly in a false direction that was predictable from his theory.

Kramer, however, has raised some objections to this theory. These are mentioned by Matthews, but one could wish that he had given them fuller treatment. Kramer, for example, claims that his pigeons are orientated within 40 secs. of seeing the sun, in which time it has moved so little that it is very difficult to believe that they could extrapolate its path accurately enough to obtain the information needed. Further, Kramer has repeated some of Matthews's experiments without always getting the same results. A full discussion of these conflicting points is outside the scope of this review; certainly it appears that different stocks of pigeons behave rather differently. But it must be emphasized that no alternative theory has so far been suggested that fits the facts so well as Matthews's.

Dr. Matthews's book is remarkably up to date, containing references to papers published in 1955. The field is a rapidly developing one, and it is most useful to have an authoritative statement of the present state of the subject. Ornithologists, and indeed all biologists, will watch the fate of the sun navigation theory with great interest. Unlike many hypotheses, there is nothing vague about it. If Matthews, Kramer and others continue with critical experiments on a large scale, it seems likely that within a few years we shall see the theory, so ably expounded in this book, superseded, or perhaps only modified, or perhaps even confirmed in all its essentials.

D. W. Snow.

## ADDITIONS TO THE SOCIETY'S LIBRARY

The following books have been added to the Society's Library since January 1955:

Review copies:

1. Indian Journal of Fisheries, Vol. I Nos. 1 and 2. By Editorial Committee, Indian Journal of Fisheries, 1954.

2. Common Indian Herbs. By N. A. Watts (The First Calcutta Local Association, Bharat Scouts and Guides).

3. Flora of Agra District. By N. A. Watts.

4. Bird Life. By Niko Tinbergen (Oxford University Press, 1955).

5. The Waterfowl of the World. By Jean Delacour (Country Life Ltd., 1954).

6. The Temple Tiger and More Man-eaters of Kumaon. By Jim Corbett (Oxford University Press, 1954).

7. Birds of Arabia. By Col. R. Meinertzhagen (Oliver and Boyd, 1954).

8. The Birds of the British Isles, Vol. III. By David Bannerman and George E. Lodge (Oliver and Boyd, 1954).

9. A Wanderer in the Wind. The Odyssey of an Animal Collector. By Cecil S. Webb (Hutchinson, 1953).

10. A Field Guide to the Birds of Britain and Europe. By Roger Peterson, Guy Mountfort and P. A. D. Hollom (Collins, 1954).

11. Poisonous Plants of India, Vol. I. By Sir Ram Nath Chopra, Rattan Lall Badhwar and Sudhamoy Ghosh (Central Government Publication, Delhi, 1949).

12. The Birds of Travancore and Cochin. By Sálim Ali (Oxford University Press, 1953).

13. BIRDS OF THE SUDAN: their identification and distribution. By Colonel Francis O. Cave and James D. Macdonald (Oliver and Boyd, 1955).

14. SOME BEAUTIFUL INDIAN TREES. By Ethelbert Blatter and Walter Samuel Millard (Second Edition, Revised by William T. Stearn). (Bombay Natural History Society, 1954).

15. SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS. By N. L. Bor and M. B. Raizada (Bombay Natural History Society, 1954).

16. THE BOOK OF INDIAN BIRDS (5th Edition). By Sálim Ali (Bombay Natural History Society, 1955).

17. NATURE PARADE. By Frank W. Lane (Fourth Edition revised and reset, Jarrolds Publishers (London) Ltd., 1955).

18. BIRDS OF SAURASHTRA: INDIA. By R. S. Dharmakumarsinhji (Published by R. S. Dharmakumarsinhji at Dil Bahar, Bhavnagar, Saurashtra and printed by Pyarelal Shah at the Times of India Press, Bombay).

19. SAMPON KI DUNIYA. By Ramesh Bedi (Publishers, Vijnayan Parishad, Prayag, 1951).

Purchased:

1. WILD COMPANY. Prefaced by T. V. Bulpin (London: The Bodley Head.)

2. ANIMALS OF THE U.S.S.R. By G. M. Vevers, F.R.C.S., F.Z.S., (William Heinemann Ltd., London: Toronto. First Published (1948).

3. WILD LIFE THE WORLD OVER. By Nine Distinguished World-travelled Specialists. (Wise & Co. Inc., New York).

4. MAN MEETS DOG. By Konrad Z. Lorenz (Methuen & Co. Ltd., 36 Essex St., Strand, London, W.C. 2).

5. THE MATING INSTINCT. By Lorus J. and Margery J. Milne (Robert Hale Ltd. 63 Old Brompton Road, London, S.W. 7).

6. GOING WILD. By Colin Wyatt (Hollis and Carter, London: 1955).

7. ESCAPE FROM THE CITY. By Homi J. H. Taleyarkhan (Popular Book Depot, Lamington Road, Bombay, 7: 1954).

8. THE INNOCENT ON EVEREST. By Ralph Izzard (Hodder and Stoughton, London: 1955).

9. LEOPARDS IN THE NIGHT. By Guy Muldoon (Rupert Hart-Davis, Soho Square, London: 1955).

10. THE FLORA OF KHANDALA ON THE WESTERN GHATS OF INDIA. Records of the Botanical Survey of India Vol. XVI, No. 1. By H. Santapau (Manager of Publications, Delhi, 1953).

11. BIRDS OF THE WORLD—Their life and habits. By Paul Barruel. Translated from the French by Phyllis Barclay-Smith. (George G. Harrap & Co. Ltd., London, 1954).

12. MANUAL OF INDIAN FOREST BOTANY. By N. L. Bor (Oxford University Press, 1953).

13. ANIMALS—My Adventure. By Lutz Heck. Translated by E. W. Dickes (Methuen & Co. Ltd., London, 1954).

14. MAN AND VERTEBRATES, Vols. I and II. By A. S. Romer (Pelican Books, 1954).

15. A DICTIONARY OF BIOLOGY (Enlarged and Revised Edition) Penguin Reference Books. By M. Abercrombie, C. J. Hickman and M. L. Johnson (Penguin Books, 1954).

16. HORN OF THE HUNTER—The story of an African Safari. By Robert C. Ruark (Hutchinson, 1954).

17. AFRICAN FURY. By George Michael (Michael Joseph, London, 1954).

18. WILD ANIMALS OF THE WORLD. By Mary Baker and William Bridges (Duenewald Printing Corporation, New York, 1948).

19. ODDITIES OF NATURAL HISTORY. By Eric Parker (Seely, Service & Co. Ltd., 196, Shaftesbury Avenue, London).

20. RAYMOND L. DITMARS—His exciting career with reptiles, animals and insects. By L. N. Wood (Robert Hale Ltd., London, 1951).

21. THE NATURE OF NATURAL HISTORY. By Marston Bates (Chapman & Hall, London, 1951).

22. ODDITIES OF THE ANIMAL WORLD. By Gladys Davidson (Blackie & Son Ltd., London & Glasgow).

23. THE ABOMINABLE SNOWMAN ADVENTURE. By Ralph Izzard (Hodder and Stoughton, London, 1955).

24. STRANGEST CREATURES ON EARTH. Edited by Edward M. Weyer Jr. (George G. Harrap & Co., Ltd., London, Toronto, Wellington, Sydney, 1955).

25. PUFFINS. By R. M. Lockley (J. M. Dent & Sons Ltd., London : 1953).

26. BIRDS AS INDIVIDUALS. By Len Howard (The Scientific Book Club, London).

27. INSECTS OF THE PACIFIC WORLD. By C. H. Curran (The Macmillan Co., New York, 1946).

28. REPTILES AS PETS. By Ian Harman (Blanford Press Ltd., London, 1950).

29. REPTILES OF THE PACIFIC WORLD. By Arthur Loveridge (The Macmillan Co., New York, 1946).

30. NINE MAN-EATERS AND ONE ROGUE. By Kenneth Anderson (George Allen & Unwin Ltd., London, 1954).

31. ANIMAL FORMS AND PATTERNS. By Adolf Portmann (Faber and Faber Ltd., London).

32. THE HUNTING WASP. By John Crompton (The Scientific Book Club, London).

33. NATURAL HISTORY OF MARINE ANIMALS. By G. E. MacGinitie and Nettie MacGinitie (McGraw-Hill Book Co., Inc., New York, London, Toronto, 1949).

Presented:

1. MOSQUITOES OF THE ETHIOPIAN REGION 1—Larval bionomics of mosquitoes and taxonomy of culicine larvae (2nd Edition with notes

addenda by P. F. Mattingly). By G. H. E. Hopkins (British Museum of Natural History, 1952).

2. A CRICACAO DE ABELHAS INDIGENAS SEM FERRA (MELIPONINAE)—The rearranging of stingless Bees, Meliponinae (In Portuguese). By Paulo Nogueira Neto (Editorial Chacaras e Quintias, Sao Paulo, Brasil, 1953).

3. EXPLORATION FAWCETT. By Lt-Col. P. H. Fawcett (Hutchinson, seventh impression, 1953).

4. THE POCKET GUIDE TO BIRDS—How to identify and enjoy them. By Allan Cruickshank (Pocket Book Inc., New York, 1954).

5. I Planted Trees. By Richard St. Barbe Baker, For. Dip. (Cantab.) (Lutterworth Press, London and Redhill).

6. YELLOW FEVER. Edited by George K. Strode, M.D. (McGraw-Hill Company, Inc., Bombay, New York, Toronto, London, 1951).

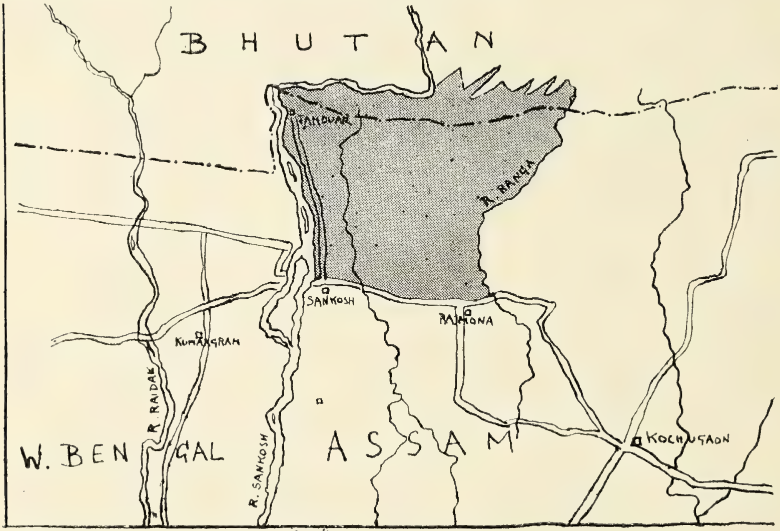
# MISCELLANEOUS NOTES

## 1. A NEW SPECIES OF LANGUR IN ASSAM

(*With a sketch map*)

For many years a golden-coloured langur has been noticed on the eastern bank of the Sankosh River in Assam, near the Bhutan border. It had been seen by several tea-planter naturalists in the Bengal Dooars, and was known to them as the 'Sankosh Langur'.

In particular, H. E. Tyndale and A. V. Pullan mentioned the existence of this langur to me several years ago, and they referred to the extraordinary fact that it had never been seen on the Bengal side of the Sankosh River, which forms the boundary between Assam and Bengal. Nor had it been seen near the Raidak River, which is the next river to the west of the Sankosh.



Scale 1" - ca. 7 Miles

KNOWN RANGE OF *PRESBYTIS GEEI*

I looked for this golden langur while I was up the Manas River in November 1949, and again in February/March 1952, but without success though I found a troupe of Capped Langurs, *Trachypithecus pileatus* (Blyth), on the 1952 trip and was able to cine film them.

In November 1953 I made a trip with friends to the rivers Aie and Sankosh. While staying at the Jamduar Forest Rest House on the Sankosh, near the Bhutan border, I was able to observe and film in colour these golden or 'Sankosh' langurs on November 17th, 20th and 21st. On 17th I came across a troupe of them rather suddenly on a hillside near the river, about two miles north of the bungalow, and saw about 12 langurs though there may have been more.

On 20th and 21st a troupe of them was encountered about one mile north of the bungalow numbering 30 to 40, feeding on the fruit (and leaves?) of *Terminalia belerica*—local names *bohora* and *bhamra*. They were shy creatures and usually kept some 70-80 feet distant, often remaining in the shade. At one time I told my two men to wait motionless while I tried to film two or three of these golden langurs a short distance away. Then followed a great commotion, and I saw a very large langur, possibly the leader, swing down branch by branch till it was only a few feet away from my men, who were very scared but remained in the same spot. Apparently this was a 'sabre-rattling' or feint attack, as the langur quickly returned to the tree-tops.

Two of my companions on this trip, while fishing on the Sankosh, told me they saw another troupe of these golden langurs some four or five miles downstream, actually on the river bed crossing from a *chapori* (island) as they bounded across the stones and disappeared into the forest.

I have been informed by B. Mitchell, who has camped in many parts of that district of Assam, that he has seen a troupe of 40-50 of these golden langurs close to the Jamduar bungalow, and smaller troupes about five miles to the south, and very small troupes of 10-15 still further away to the south-west, near the Raimona Forest Rest House. He has also, he says, seen a troupe of about 25 of them on the west bank of the Ranga River, but none to the east of the Ranga.

All the places referred to above, which comprise the known range of this golden langur, are within an area of not more than about 56 square miles, extending from the east bank of the Sankosh River to the west bank of the Ranga River, and from the Sankosh-Raimona road in the south to the Bhutan border (or further?) in the north.

As for a general description, these golden langurs appear to be similar to other langurs, except that the tail is longer and slightly tassellated and the coat is an almost uniform deep cream colour in dull light and bright golden in sunlight. The face is black. The coat down the sides, where the hair is longer, appears sometimes to be darker, almost red in colour. The young appear to be similar to the adults, though perhaps a little lighter in colour.

I was not able to secure any still photographs of these langurs, but succeeded in taking about 70 feet of 16 mm. colour cine film of them as they moved about the tree-tops.

In August 1954 I reported the existence of these golden langurs to Dr. W. C. Osman Hill of the Zoological Society of London, a leading authority on the Primates, and he considered that they might be a new species. Again I reported their existence to the Zoological Survey of India in January 1955, and I suggested that their Survey Party, then working in Bengal, should visit Jamduar in order to collect specimens for identification.

This Survey Party led by Mr. H. Khajuria duly visited the area and collected six specimens in April of this year, and the description and report of this Party is now awaited with interest, as this golden langur may be a species entirely new to science.

OATING P.O.,
ASSAM. E. P. GEE
*August* 11, 1955.

[We understand from Mr. Khajuria of the Zoological Survey of India that his description of this new species of langur, which he has named *Presbytis geei*, will shortly be published in *Annals and Magazine of Natural History*—EDS.]

## 2. MONKEYS AND PANTHER

With reference to the first Miscellaneous Note in Volume 52, No. 4, the following extract from an account in my diary of what appears to be another good example of 'mass hysteria' amongst langurs in the presence of panther may be of interest to readers of the *Journal*. It refers to an incident near Tanakpur which I recorded in November 1939.

'Late one afternoon I was sauntering quietly down a jungle path near the forest edge. Suddenly I froze in my tracks, for meandering towards me was a really fine chital stag. I hadn't the slightest wish to shoot him; rather did I feel like bursting into laughter for he was mooning along the path seemingly without a care in the world, occasionally inclining his aristocratic head to one side or the other as if he were aware of its beauty; occasionally he nuzzled a strand of grass leaning across his path. He was not forty yards away, yet quite oblivious of my presence and so taken up with his dreaming that he performed a little sideways dance, lowered his head in mock battle, and then walked on as nonchalantly as before. His preoccupation was quite ludicrous to see, but it might well have proved his undoing.

Some fifteen yards to his left was a narrow belt of shisham trees, near the summits of which a dozen or so langurs were nibbling the young shoots and watching my movements with but little concern. On the chital's immediate right was a wall of tall thatching grass seven or eight feet high and stretching back some fifty yards to the edge of the sal trees. Without a moment's notice pandemonium broke loose amongst the monkeys. Never was such unbridled panic, and why they forsook the safety of the shisham trees God alone knows. With volleys of grunts, squeals, and frenzied chatterings they burst in all directions like a startled covey of quail, surged across the path and through the tall grass in an effort to reach the main forest. So taken up was I with this amazing stampede that for an instant I forgot the stag. When once more I glanced down the path, he had melted from my ken. But even as I pondered on his disappearance, from out the elephant-grass there burst through the clamour an awe-inspiring sigh. I can only describe it as a sigh, a sigh which was indeed all breath and little noise and yet seemed to shake the air. It was followed (or was it preceded?—in the confusion I forget which) by the agonized scream of a dying langur. In the excitement of the moment I pushed a little way through the cover in the direction of a tall anthill. Discretion quickly sent me back to the path, for a low growl, too imperative to disregard and too near for comfort, warned me not to interfere.

Much had been enacted before my very eyes, and even more had come to my ears, yet the correct interpretation of those crowded moments probably eludes me. Is it not possible that one of a pair of leopards, from beyond the shisham trees, caused those foolish monkeys to run in terror from his presence while his mate lay ready in the concealing grass? At any rate, I like to think that the chital stag had no place in the violence of that scene; he was far too happy and beautiful.'

HAYBARN,
THURSLEY, R. S. P. BATES,
SURREY. *Lieut.-Col.*, I.A. (Retd.).
*September* 25, 1955.

## 3. THE BICYCLE TIGER

On a nearby tea estate there have been, recently, two unusual cases of a tiger attacking people on bicycles in daylight. The first occurred some two months ago when a Dispenser of the estate was knocked off his machine by a large tiger which sprang out from the tea which borders the road. He was virtually unhurt, but the cycle tyres were ripped—presumably by the animal's claws.

The second 'assault' took place on 10th September, 1955. The Manager was peacefully riding along a road which borders some abandoned tea, i.e., the bushes have been allowed to grow unpruned and unplucked, when he was startled by a squeal which came from the other side of the road. He stopped to investigate and at the same instant, 'a huge tiger emerged from the abandoned tea and approached me at a crouching run. I pedalled off as fast as I could with the tiger effortlessly keeping pace behind. After going a few yards I began to shout. Then I fell off. I don't remember anything more until I "came round" to see some labourers bending over me. Apparently, on hearing my shouts, they came in my direction and the tiger made off.'

The Manager was also almost unscathed, but the cycle tyres were again ripped by the animal. The only really satisfactory explanation for these two attacks appears to be of a psychological nature. That the tiger harbours a phobia against cycles seems likely—in particular against the admirable products of M/s. Dunlop, Firestone, etc., for in both instances he could have killed both men with very little trouble, yet he seems to have concerned himself solely with the machine. His actions were, apparently, unprovoked as the source of 'the squeal' was not discovered. In the case of the Dispenser, the only sound emanated from himself!

There is another explanation, however, which should be taken with raised eyebrows, I think. Ten years ago the previous Manager of the estate, a man of generous proportions, was reported to have bumped into a tiger whilst riding his cycle. Elephants are said to never forget, but tigers, well . . . ?

KHARIKATIA T.E. & P.O.,
ASSAM. J. H. BURNETT
*September* 12, 1955.

## 4. WILD ANIMALS IN THE ANDAMAN ISLANDS

The only wild animals in the Andamans at present are Chital and Pig. Chital were introduced in the Andamans some 25 to 30 years ago with the object of creating a source of meat for those who have to live and work in the forest. They are now, however, classed as pests, as they have increased and multiplied beyond all measure and are destroying the seedlings of valuable commercial trees in our regeneration areas. To counteract them, two female panthers were introduced in the Andamans during the year 1952-53, but their activities cannot so far be judged.

PORT BLAIR,
ANDAMANS. J. BANERJI, I.F.S.,
*August* 3, 1955. *Chief Conservator of Forests.*

## 5. GREAT INDIAN ONE-HORNED RHINOCEROS (*R. UNICORNIS* LINN.) COW WITH (PRESUMPTIVE) TWIN CALVES

On July 24th 1955 at about 2.30 p.m. I set out from Kaziranga village on the elephant 'Deokali,' accompanied by Choudhuri, the Forest Guard. It was my intention to visit the nearest part of Kaziranga Sanctuary, which is about one mile away at this point. As we approached the Mora Difloo stream, which forms the southern boundary of the Sanctuary, we observed at a distance two or three rhino grazing in the Sanctuary beyond, in a grassy clearing locally known as a 'doloni'.

We eventually arrived at the bank of the stream, and at a distance of only about sixty yards gazed at the rhino. There were three of them: a mother with her calf close to her, and about twelve or fifteen yards away to the left another calf—presumably without its mother. We looked around for the mother of the lone calf, but there was no other rhino in that place.

As we discussed the problem of how this lone calf came to be there, the young creature itself solved it for us. It heard us talking, looked up and then immediately ran to join the mother and the other calf. Then it dawned on me that this must be the first case of an Indian rhino ever being seen with twin calves.

We had ample opportunity of closely observing the cow with her two calves, for they remained in the same spot for some fifteen minutes. The calves were about three years old, and were of identically the same height and shape. They roamed together round the mother as she continued to graze, and we were able to observe them facing us, side view and rear view. As there was no other rhino in the place at that time, there can be little doubt that it was in fact a case of twin calves.

Most unfortunately it had been raining slightly all day, and so I had come out for once without a camera. In order to obtain more witnesses, if that were necessary, we called up several villagers who were fishing and herding their cattle nearby, just outside the Sanctuary. They came along, looked and confirmed without hesitation what we had noted—that here was a cow rhino with twin calves.

Eventually the mother rhino became a little nervous at the sight of so many of us, and walked away into the tall elephant-grass. The two calves followed close at heel and disappeared from view. I advised the Forest Guard to keep a careful look-out for further appearances of this unique family party.

Several cases have been recorded of twins being born to an Indian elephant; but as far as I am aware no case has hitherto been reported of the Indian rhino, or of any rhino of either Asiatic or African origin, having twin calves. The above occurrence, therefore, must be the first ever to be observed and recorded.

Oating P.O.,
Assam (India).
*July* 28, 1955.

E. P. GEE

## 6. A SUPPLEMENTARY NOTE ON THE STATUS OF RHINOCEROS IN THE UNION OF BURMA—1955

### The Smaller One-horned or Javan Rhinoceros. *Rhinoceros sondaicus*.

Extract from a letter dated 2nd September 1954, from the Deputy Commissioner, Tavoy (U Kyaw Thant):

'On my recent tour to the newly occupied area which was under insurgent domination for some time, I came across a piece of rhino hide and a tip of rhino horn about a couple of inches in length cut from the horn. According to the person who was in possession of these things, a single-horned rhino was seen at Taungnyo range (a local name for the Tenasserim Yoma) in Natkyizin village tract by Mon insurgents. Natkyizin village tract is in the northern part of Tavoy District bordering the Amhurst District. This was some time in January 1954, and the animal had to be stalked for about half a day before it was shot. According to this person the horn was about 9 inches in length and about 3 inches in diameter at its base. It is said there was only this one rhino when it was seen.'

It is possible that this rhino is the same animal as mentioned in the Annual Report on Game Preservation in Burma for the year ending 31st March 1940. Below is the relevant extract.

'In the Man-Aung and Yechaung Reserves of Ataran Division recent tracks of two rhinoceros were seen and a search by the local beat officer in the adjoining area of Tavoy Division produced another track.'

THE SUMATRAN TWO-HORNED RHINOCEROS, *Dicerorhinus sumatrensis.*

Extract from a letter dated the 18th May 1955 from the Divisional Forest Officer, Minbu Forest Division (U Su):

'It has very recently been reported to me that there are some rhino in this division. Very recently some villagers from Nga-pe area had seen a rhino in the Pa-aing Reserve while collecting canes for their use, and also stated that some tracks were frequently seen in the Mon West Reserve and Kyetmauktaung area. From the reports it seems that there are not less than 3 to 5 rhinoceros in this division, probably *Rhinoceros sumatrensis.* I think they must have been wandering across from the Arakan Yoma.'

Mr. J. N. Martin, Superintending Engineer, who has been supervising the construction of the Padaung-Taungup motor road over the Arakan Yoma was informed by local trackers that there are rhinos in the Nga-pe area, three days' march from Yebawgyi-Mile 70. This coincides with the report received by U Su. Nga-pe area is near An Pass, and is lower down the area marked some 50 miles SSE. of Myohaung in Lieut.-General Philip Christison's map (*JBNHS*, Vol. 45 (4), pp. 605—1945).

According to Mr. Martin's informants, rhino tracks are no longer seen in the area about half-way between Sandoway and Prome.

25, INYA MYAING ROAD,
UNIVERSITY P.O.,
RANGOON, BURMA.
*July* 4, 1955.

TUN YIN

## 7. WILD BOARS BEING USED AS BLOOD HOUNDS

I wonder whether the readers of this journal have ever known a case of wild boars being used as blood hounds.

There is a place called Badnor in Rajasthan where the Thakur Sahib of this place used to keep a couple of tame wild boars some years ago. These wild boars were so trained that whenever a panther was wounded and required following up, these boars used to be let loose on him. They would at once pick up the blood trail, and on encountering the wounded panther would hold him at bay until the shikaries came and despatched the panther.

On enquiry I was informed that these boars while young were first taught to lick the blood of a goat and later to follow its trail laid for the purpose.

Since no accidents were reported while following a wounded panther in this novel way, it would certainly appear to be a very safe method of following up wounded carnivora.

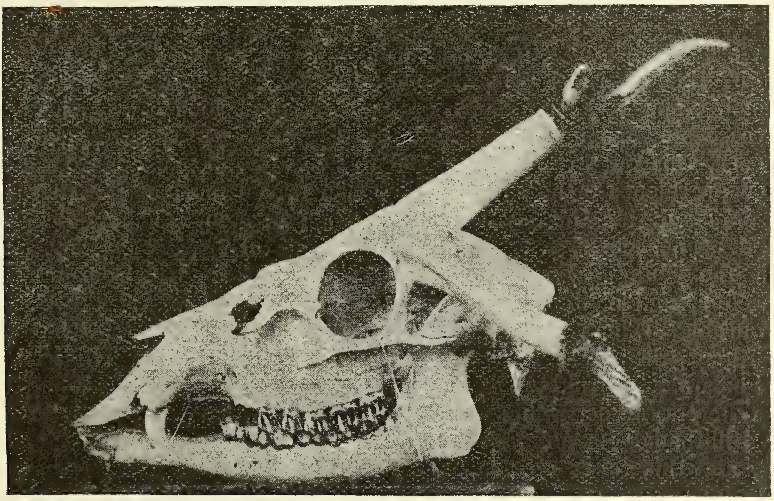
Banera P.O.
Rajasthan.
*August* 19, 1955.

K. GUMAN SINGH,
*Colonel*, I.A.

## 8. MALFORMED MUNTJAC HEAD

(*With a photo*)

In connection with my recent reference to an abnormal Sambar antler another abnormal deer skull has come into my possession. In this case the skull is that of a Barking Deer—*Muntiacus muntjak*: Malay—Kijang.



This deer was shot on licence during the past open season and is of a fully mature male. It was in excellent condition.

The abnormality is in the left pedicel which, instead of growing upright has grown downwards and backwards past the left ear. This abnormal pedicel measures 3½ inches from the angle of the skull above the eye socket, and the horn from the burr only 1¼ inches. The horn is very worn and stubby.

At the base of the abnormal pedicel, where it joins the front of the skull, there are two projections. One is half an inch long and the other, slightly above the first, is merely a small knob of bone. There are no signs at all of damage or injury to the abnormal pedicel or the bone structure at the base and the small projections appear to be projections from straight clear skull bone.

The normal pedicel measures from the base at the back 3¼ inches, and the horn from the burr 3½ inches.

In view of the absence of damage to the pedicel and the bone tissue in that region it would seem that this abnormality was present before the animal was born and that the projections on the skull near the base of the abnormal pedicel are the indications of one—if not two, additional pedicels which failed to form.

HQ. GAME DEPARTMENT,
FEDERATION OF MALAYA,
SEREMBAN,
NEGRI SEMBILAN,
MALAYA.
*May* 25, 1955.

H. J. KITCHENER, F.Z.S.

## 9. THE STATUS OF THE NILGIRI TAHR OR 'IBEX' (*HEMITRAGUS HYLOCRIUS* BLYTH)

As a result of letters appearing in the Press to the effect that Nilgiri Ibex in these hills were on the verge of extinction owing to poaching and indiscriminate shooting, it was decided to hold a census of these animals in order to ascertain the exact position. An attempt to carry this out in May 1954 had to be abandoned owing to the unusual prevalence of horse-flies which had driven most of the Ibex into the *sholas* during the daytime, and to the persistent rain and low-lying cloud. The census was therefore deferred till April 1955, by which time the young grass on burnt areas would bring the Ibex up from the cliffs, and it was hoped that other conditions would prove more favourable. The result was most satisfactory.

Along the great 20-mile sweep of the cliffs from Nilgiri Peak to Sispara and Ankinmalai no less than 296 Ibex were counted in 17 different herds, while an outlying herd of 42 was enumerated in the Billithadahalla area. The grand total actually seen was therefore 338, and this takes no account of others which may have been overlooked or were out of sight down the cliffs. The figure given may be accepted as accurate, since great care was taken to ensure that no herd was counted twice over. This was not difficult as the lure of the fresh grass kept the animals located. The result of this census shows how far from the truth is the idea that Ibex on the Nilgiris are on the verge of extinction.

Only in the small isolated Glenmorgan area on the northern side not a single animal could be found, nor any droppings, and it would appear that this herd, which in 1947 numbered some 30 head, has been wiped out by poachers, in spite of the fact that the area has been closed to Ibex shooting for some 20 years. Elsewhere, on the main Ibex grounds between Nilgiri Peak and Bangi Tappal, poaching is mostly confined to gangs of Estate workers armed with spears and accompanied by packs of dogs. It will be appreciated how difficult it is for an unarmed Watcher or Forest Guard to deal with these, though the presence of sportsmen does act as some deterrent. Licence holders on an average account for only two Ibex per annum, and those are 'Saddle-backs', i.e., old males, of doubtful utility for breeding purposes.

It would be interesting to know how Ibex are faring in other hill ranges of the South—the Anaimalais, Palnis, High Range, etc. Perhaps our members could give information.

KALHATTI,
NILGIRIS.
*June* 14, 1955.

E. G. PHYTHIAN-ADAMS, *Lieut.-Col.*,
*Hon. Supdt., Nilgiri Game Association.*

## 10. THE FAMILY LIFE OF A FIVE-STRIPED SQUIRREL—(*FUNAMBULUS PENNANTI* WR.)

In 1953 October I found a young squirrel by the wayside which had dropped from her nest. The crow and the kite had missed her. I reared her on warm milk which she sucked from a piece of cotton dipped in it, and then gradually as she grew up she fended for herself but still insisted on a daily ration of delicacies such as top of the milk, coffee and sweets. I have watched her make a dash for a resting honey-bee or a fly and devour it with relish, wings and all.

By June 1954 she was full grown and had a wooden box lined with cottonwool in which she slept at night. This box of hers was kept in a small almirah built in the wall. To come out in the open she had to jump on to the frigidaire, then on to a curtain, rope-dance along a wire to another almirah, and finally come down by the wire-meshed door on to the courtyard. There was an easier route along the casing but it never seemed to appeal to her.

On June 8, 1954 while I was immersed in a book, my pet squirrel came into the room and sat on the top of the door. The next moment she gave one of the sweetest calls I have ever heard, followed by a second and a third call, at short intervals. There was an answering call at a distance, not as musical though certainly appealing. The calls became more frequent and more in number as they came nearer, and it seemed to me they were far too many to belong to one since there was such a wide range and variety in pitch. Bewildered, I peeped out from behind the curtains on to the courtyard, and imagine my surprise when I saw trooping down the stairs of our double storeyed house, not one, not two, but as many as eight squirrels of different shapes and sizes. One was certainly old and tottering, another with just half a tail, and a third sleek and debonair. For the first time I realized that the female of the species takes the initiative to let the squirrel world know that she is ready. But one factor, I am certain she had not bargained for, was the terrific onslaught that followed, because the next moment she was hotly pursued up the casing, down the curtain and behind the couch. The suitors fought among themselves for supremacy, but for her there was a constant urgent appeal in the voice as each pursued her. Finally at an opportune moment the debonair suitor, handsomest of the lot, softening her by his coaxing call, quickly caught her in a clasp and mated. She struggled at first to unloosen the grasp, and on failing to do so, submitted quietly. For about 15 minutes they remained thus until disturbed by another inquisitive squirrel. The female squirrel came to life as it were, and with a turning bite freed herself and ran, followed closely behind by the surprised mate. He caught her up again but now she was not unwilling. They mated a third time in the course of the day and quietly, because the other squirrels had quit the field, so to say.

The love life of a squirrel lasts but just one day. The next and the following days not a single squirrel could be seen, nor did the female send out her urgent calls again. Alone and unaided she makes her nest and rears her young, the male being but a day's visitor.

Soon after, she brought in strips of cloth, a ball of thread she had managed to slip out of the sewing bowl, and finally, unseen by me, a handkerchief of mine to line her already lined wooden box. Before long she turned plump and round, and on the morning of July 18, exactly one month and ten days after mating, she came out of her box as slim as ever. I was certain she had been delivered the night before, and I was keen to see the litter. She who was such a pet to let me handle her became so possessive that she turned ferociously on me the moment I went up to her almirah. Outside it she let me feed her.

That night tragedy overtook her family. Early next morning I was surprised to find her, not in the box suckling her young ones, but constantly getting in and out of the box. She was letting out the most pathetic squeaks, and she would not allow me to find out what was wrong. Unable to stand her sorrow any longer I drove her out of the almirah and out on to the courtyard and locked the doors. I took down the box and looked in and only then could I understand the cause of her pain, for it shook me to find just a few pieces of meat, the remnants of her first-born.

I threw out her nest, cleaned the box thoroughly, aired it and put fresh cotton wool for her, then let the doors be opened. She went straight for the almirah, and finding her old nest and everything thrown away, went on with her squeaks that were nothing less than wailings for her lost litter. Fortunately she calmed down by late evening and was normal the next morning. I was still wondering who had destroyed her family when I heard a commotion. On entering the room I saw a huge sewer rat on the casing and my pet squirrel appealing for help at the top of her voice. Then it struck me that these rats enter homes during monsoons when their own burrows fill with rain water. The night before, he had come down the casing, found the almirah open, frightened the mother squirrel out of the box and then had made a meal of the young ones. I learnt my first lesson. Since then I close the doors of the almirah at night and open them early every morning.

Within a fortnight of that tragedy my squirrel had so recovered that she again advertised the fact that she was ready for her suitors. On August 5, 1954 she went through the whole drama of June 8, but I cannot tell for certain whether the mate she chose the second time was the same as the first, because there is no way to tell them one from another unless there is a tail missing. This time they mated twice in the course of the day, and on each occasion for a longer period, 20 minutes at a time.

On September 16 she turned ferocious again, and when I went to feed her she ran down the almirah, up my dress, took hold of my middle finger, gave a sharp nip and went back to her box. I looked foolishly at my bleeding finger, and learnt my second lesson. Now, every time she becomes a mother I give her the widest possible berth.

The first thing she did each morning was to leave the nest for half an hour for fresh air, food and exercise. I took that opportunity to peep in, and found three very small, blind and absolutely hairless young ones. To suckle those fast growing, hungry mouths the mother squirrel had to have ample milk in her four teats, so that now she consumed double her normal diet with short intervals between feeds. When once full she went to suckle her young ones until they slept on a full stomach. Then she would come out of the box and keep watch, stretched out on the lid, and there take forty winks herself.

In three weeks their eyes opened, squirrel markings appeared on their now furry backs, and it was at this stage that I took one of the litter to bring up myself. When the two young ones grew in size and the box became uncomfortable for suckling, the mother would bring them out of the box, and in the almirah curl herself like a dog while the young ones held furiously on to the teats. Even when they could fend for themselves they would insist on being breast-fed now and then, and the mother made no objection.

Gradually she brought them out and taught them the way to the courtyard, but there was always a fall or two when the mother would show remarkable patience. On one occasion I watched her from 12 in the afternoon to 8 at night trying to induce a young one back into the almirah after he had accidentally fallen out through sheer inquisitiveness. With her success I learnt my third lesson, that perseverance knows no failure.

The moment she taught them to go free she refused to have them in the box, though out in the courtyard she fondled them once or twice. One great difficulty I came up against was that I could not freely bring up the young I took from her box. She refused to recognise her offspring because the human hand had obliterated the original smell and she would chase him about and bite, with the result that to this day I have failed to bring up a single young one. Invariably she would so chase them about that the ones she reared as well as the one I brought up would disappear, thinking it better to live a squirrel's life of freedom than a dog's life in a courtyard!

One characteristic that I noted in my squirrel was that she spurned male attention while the young ones suckled. I have seen the male making advances with soft calls, but she would turn round, attack and so chase him that he thought it wiser to run for his life and leave the territory in her possession.

The moment she showed hard-heartedness towards her own offspring I knew she was getting ready to bring up another family. Thus on December 4, 1954 she conceived for the third time and one month and twelve days later brought into the world, a litter of three on January 16, 1955.

I do not know if squirrels are as prolific in the wild state as in captivity, because on March 10, she mated again and gave birth on April 20, 1955 to three young ones, her fourth litter.

One from this litter I brought up, and one day when he was alone he went to investigate a table fan in motion. Fortunately, I had just come into the room to find him on the ground twitching his legs, and the nose was bleeding. Quickly I took him up and sat through the whole afternoon rubbing his nose and body with ice while he lay limp in the palm of my hand, whimpering. That night I just could not put him down fearing to find him stiff and cold the next morning. I lay under the starlit sky with the injured body against my heart to keep it warm, and time and again my hand felt for its heart-beat. For the next two days he was in a comatose condition taking very little milk, and that little with great difficulty, but from the third day onwards he recovered enough to lead a normal life.

There was certainly a slight concussion of the brain, for he walked in circles and had lost the use of one hand. In spite of this he flourished but his mother gave him no peace and chased him up and down. One day I lost my temper and drove her out of the house though I knew she was carrying, for she had for the fifth time mated on June 15, 1955. In retaliation she too refused the hospitality of the house, and for the first time made a nest for her future litter in a crevice of a wall in the compound next to ours. In the meantime the maimed youngster, a month after his accident, vanished into thin air. He chose the road to freedom.

Now and then I would see my squirrel come to the courtyard for food since her hunger had sharpened as her days were drawing nearer the delivery. Then on July 26, 1955 she came down slim and famished, a proud mother again. She ate voraciously, then went through her box which had not been removed, and returned to her young ones. She came every day for her ration, investigated her almirah and then went back.

Then came a terrific downpour lasting two days and I hoped that the mother would see sense and not let pride ruin her litter. On August 17, 1955 during a brief respite from rain I looked up to see the mother coming down the stairs with her young held by the nape of the neck. She dropped her burden in the box and made trip after trip bringing her litter of three, and the nest as well.

Yesterday, August 19, I took a young one out, and while I was typing this article he started bawling for milk bringing the mother down to investigate ! She coolly looked at me, came to my lap, sniffed at her offspring and lay down to suckle him. When he was full she rolled him into a ball, gathered him up and carried him back to her box while I sat and watched, and inside me there was such peace and happiness that I decided to let her keep her family.

SUNNY VIEW,
SAHARANPUR, U.P.
*August* 29, 1955.

(MRS.) ARUNA BANERJI

[As will be seen, the period of gestation in every case above was between 40 and 42 days, and the size of the litter 3 young, which seems to be the norm.—EDS.]

## 11. ATTACHMENT TO WINTER QUARTERS IN MIGRATORY BIRDS

On the night of 20th March 1953, Shumoon Abdulali drew my attention to a female redstart (*Phoenicurus ochrurus*) which had spent the cold weather in his garden at Thana, Salsette Island, Bombay. It was roosting on the stem of a banana leaf about 5 feet above ground when we caught it by hand and placed a red plastic ring upon its leg. The bird was not seen again, possibly having migrated northwards soon after; but on 16th October 1953 it was back in the garden and spent the winter in the same area. It was last seen on 23rd March 1954.

On 23rd October 1954, a female redstart flew into the house and was captured. It was *presumably* the same individual, but the ring had been lost. A fresh ring was placed on its leg and the bird stayed in the area till the end of March 1955. A look-out will be kept for its return in autumn.

In the *Journal* Vol. 47, p. 161 Sálim Ali has recorded a Grey Wagtail which visited his lawn at Bandra for several consecutive years. It is well known that birds commonly return to the same place for nesting purposes, but it would appear that this habit of individuals spending their winter in the same area is also not uncommon and applies to many species. What is it that makes one bird stop in Bombay while its mate, or perhaps others from the same brood, go right down to Ceylon?

c/o FAIZ & CO.,
75 ABDUL REHMAN ST.,
BOMBAY. HUMAYUN ABDULALI
*May* 30, 1955.

## 12. ADDITIONS TO THE BIRDS OF THE PALNI HILLS, SOUTH INDIA

I recently sent to the Bombay Natural History Society a list of birds collected by me in the Palni Hills and now in the Shembaganur Museum. Subsequent to this the Society prompted me to collect some additional specimens, and I append a list of the species which I understand have not been recorded from the Palnis, together with such short supplementary information as is available.

The parenthesis immediately after the name indicates the place and date where the specimen was collected. Those of my specimens now in the Society's collection are marked with an asterisk. The latter were identified by Mr. Humayun Abdulali, and his notes are included in square brackets.

**Copsychus saularis ceylonensis** Sclater. ♂ 27-4-54, ♀ 2-1-55 Shembaganur. A few of these birds are present throughout the year at Shembaganur, though more rarely seen during the winter months. They are common in the foothills where a specimen was obtained on 19-5-55*. I have also seen it at Kodaikanal (7,200′) on 1-5-55, where it is rare.

**Geokichla citrina cyanotus** (Jardine and Selby). ♂ and ♀ Perumalmalai Coffee Estate, 5,000′, 1-5-55*.

**Lalage sykesi** Strickland. ♀ 5-2-55, ♂ 10-2-55 Shembaganur. Pairs may be seen at Shembaganur in February and March. I have seen them in the foothills in May. This year I saw one on 19-5-55.

**Dicrurus longicaudatus longicaudatus** Jerdon. ♂ 17-11-53 Shembaganur. Common at Shembaganur from October to March. A specimen ♂ was collected on 5-3-55*.

**Oriolus oriolus kundoo** Sykes. Foothills 22-2-55. Another specimen was obtained at Shembaganur (6,000′) on 8-3-55*. It may be seen occasionally at Shembaganur during the winter months and is absent at other seasons.

**Galerida malabarica** Scopoli. 20-5-54 Perumalmalai. I came across flocks of these birds on 20-5-54 on the stony slopes of Perumalmalai (5,000′), but when I returned to the identical spot this year on 1-5-55, there was not a single specimen to be seen there nor elsewhere within a radius of one mile. Not seen at Shembaganur.

**Pitta brachyura** (Linnaeus). 25-10-53, ♀ 27-10-53*, ♂ 28-10-53 Shembaganur. During a fortnight of heavy rain in the latter half of October 1953, six crashed into the walls of the verandahs at Shembaganur between 7 and 9 p.m, and disabled themselves. Two of these specimens were sent to the Society. One more was picked up in a similar manner the following year, and another shot in December at Perumalmalai.

**Dinopium javanense malabaricum** Whistler. 2-3-54 Perumalmalai. My only record is a nesting pair shot at Perumalmalai on 2nd March 1954. The nest, which was inaccessible, was situated in a hole made in a dead tree, about 30 feet from the ground in a dense ' shola '. I have not seen this bird at Shembaganur.

**Taccocua leschenaulti leschenaulti** Lesson. ♀ 19-5-55* Palni Hills, 1,000′.

**Bubo bubo bengalensis** (Franklin). ♂ 7-5-55 Palni Range*.

**Otus bakkamoena** subsp. ? 31-12-54 Kodaikanal, 7,200′ 2 ♂ 8-5-55. Manalur Cardamom Estate, 4,000′. At Manalur on 8-5-55 there were four in the hollow of a dead tree, the entrance hole being about 30 feet from the ground. The first one on being shot, fell into the hole and could not be retrieved. The report of the gun brought three more out of the hole, of which two were collected. One of them is a juvenile.

[There is no specimen from South India available for comparison, but the juvenile differs from one from Chikalda, Berar, and from the description in Sálim Ali's 'Birds of Travancore and Cochin' (p. 283) in not having the head grey but rufous, as also the upper back. In both the present specimens the second and subsequent primaries are rufous as compared with white in the others.]

**Galaucidium radiatum radiatum** (Tickell). ♂ ♀ 8-5-55*. Manalur Cardamom Estate, 4,000'*.

[*Malabaricus* occurs in the moist forests of Travancore and Cochin and in the Nilgiris, northwards to Ratnagiri in South Konkan. A series from North Kanara contains specimens which can be placed with both *radiatum* and *malabaricus*, but those from Bombay, Khandala and Mysore are *radiatum*. It would be interesting to determine the factors that control the distribution of these two races.]

**Pseudogyps bengalensis** (Gmelin). 17-9-54 Perumalmalai. I have seen parties of about six birds over Shembaganur in February and March. One more was seen at Perumalmalai on 1-5-55.

**Falco tinnunculus objurgatus** (Stuart Baker). ♀ 12-5-55 Kodaikanal, 7,000'*.

[The Kestrel has been recorded from the Palnis, but it is worth while recording the present specimen, since it determines the race. The type locality of *objurgatus* is the Nilgiris.]

**Spizaëtus cirrhatus** (Gmelin). 27-2-55 Perumalmalai. A female was collected at Perumalmalai on 27-2-44. I have no other record of this bird.

**Circus macrourus** (S.G. Gmelin). 28-2-55 Perumalmalai. Two females shot at Perumalmalai on 28-2-55 and 8-3-55 were sent to me. I have not come across it myself.

**Astur badius badius** (Gmelin). ♀ Foothills 7-9-54. Not seen at Shembaganur, but two ♀ specimens were obtained in the foothills on 7-9-54 and 19-5-55*.

**Accipiter virgatus besra** Jerdon. 6-3-55 Shembaganur. A female was obtained at Shembaganur on 6th March 1955. No other record.

**Pernis ptilorhynchus** Temminck ♀ 20-11-54 Shembaganur. Common at Shembaganur in winter, mostly in December. I once saw 6 at one time at 4 honeycombs on a eucalyptus tree. As the branches overhung the road, passers-by were stung by clusters of angry bees which fell from the combs as the birds pecked at them.

**Turnix tanki tanki** Blyth. ♀ 15-10-53 Shembaganur. This was brought to me alive. I have no other record.

LOYOLA COLLEGE,
MADRAS. NORMAN A. FULLER, S.J.
*September* 21, 1955.

## 13. TRAPPING BIRDS FOR RINGING

(*With eight text-figures*)

Mr. Zafar Futehally's Miscellaneous Note (Vol. 52, p. 936) on 'Trapping Birds for Ringing' leads me to suggest the trial in India of a trap I constructed in 1946 shortly after arrival in England pending retirement. With other enthusiastic members of a newly formed Natural History Society I helped to work two of the usual large Heligoland traps and also ringed young birds in the nest. These two methods by no means tapped all sources of supply of the local avifauna and we found ourselves wanting to get at large numbers of wagtails, sandpipers, redshank and other waders which frequented the local sewage works. I tried a yard square box-trap put down on the muddy margins of the beds, but in general the birds avoided it and the few we did catch in it proved hard to remove as they often refused to find the right way into the collecting box at one end of the back. They seemed loth to enter this trap anyway, but when I tried sloping the front so that they were virtually past the entrance before they had a roof over their heads we had some success. Cogitating on this and other modifications which suggested themselves, I eventually constructed a highly successful trap which captured 140 birds in a six weeks try-out in my own and a friend's garden, the first recovery amongst which, a blackbird, was effected in Denmark a fortnight after being ringed. Incidentally, I captured 5 starlings together, but starlings are exceptionally strong birds and I lost two of them through waiting to see if, *en masse*, they could push the door open. The species caught were of course common garden birds, Great and Blue tits, robins, dunnocks, starlings, blackbirds, thrushes, chaffinches, a single Coal Tit (the only one seen in either garden), and a single mistle-Thrush. The last was unconcernedly preening inside the trap after feeding on the bright red mountain-ash berries I had used as bait, and only seemed mildly surprised when the gate was dropped.

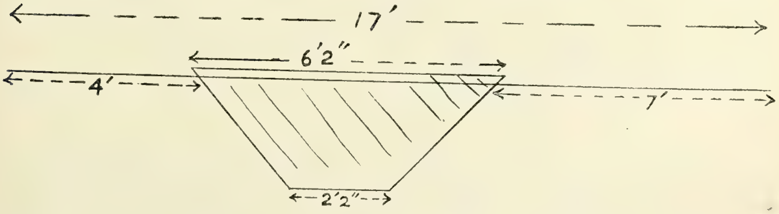
There appear to be two main advantages in this trap over the more conventionally shaped square or oblong affairs. Firstly, birds seem less shy of entering than they do those with upright fronts. Secondly, once inside with the ringer approaching from the front, they automatically go straight into the box and often stay there. There are perhaps one or two other points worthy of mention. It is easy to make and at low cost. Although fairly bulky, it is quite light and two or three can be stacked one on top of another for transport, taking up little more room than a single trap.

It is hardly necessary to mention that this is not an automatic trap; it is in fact necessary for the ringer to be somewhere near the end of a long string ready to let the gate fall when a bird is well and truly inside. I see little disadvantage in this as it is really necessary to remove trapped birds from any trap, automatic or otherwise, within as short a time as possible if they are not to come to harm. In any case I am sure an automatic version could very quickly be devised. The release string should be attached near the bottom of the release rod and should not be too loose. If slack has to be taken up the bird, startled prematurely, may be flying out and so be hit and injured by the falling door. On the other hand, don't leave it so taut that it is just off the ground and swinging in the breeze. Many birds will be frightened by it in such a position and most will refuse to cross it.

The baits tried here have at different times consisted of mixed canary seed, pinhead oatmeal, barley, bread crumbs, fat, cheese rind, and lastly coconut. Of these, barley proved unacceptable to all species ! Bacon fat, coconut, and cheese rind attracted tits, the latter being particularly effective, while rape seed proved almost irresistible to finches. But pinhead oatmeal is perhaps the most useful bait of all, being eaten by nearly every species in the garden including both tits and finches. Starlings were attracted by some larger pieces of bread amongst the crumbs, but tits have a habit of nipping into the trap and carrying these off as well as any other loose bait. It is advisable therefore to hang up most of the larger things in a deep basket made from a piece of the half-inch wire-netting. This has resulted in a great saving of bait and has stopped piracy on the part of starlings and Jackdaws awaiting their chance in the neighbouring trees. For India many other forms of bait will suggest themselves, more suited to the differing forms of bird-life. Millets, for instance, for finches; ants' eggs, termites, etc. for insect eaters. In fact I see no reason why this trap should not prove as effective in India as it has done in England. Here then are the details of its construction.

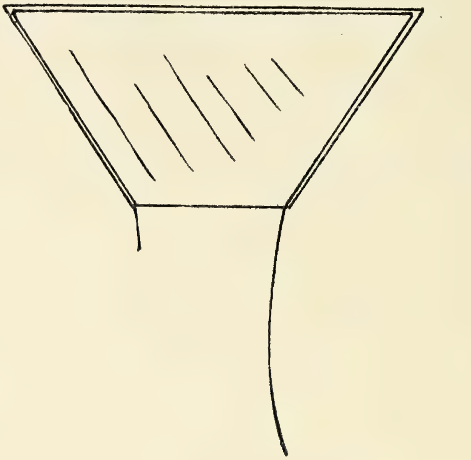
## CONSTRUCTION

Stage 1. Cut a strip of ½ inch mesh, 3 ft. wide wire-netting to the dimensions shown, and thread a 17 ft. length of 8 gauge galvanized wire through its leading edge. It will slide quite easily if worked through the mesh at about 6 inch intervals, beginning and ending one inch from each end of the netting.

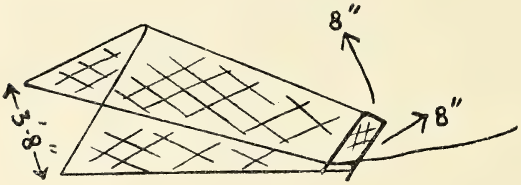


Stage 2. Bend the wire along the converging ends of the netting. This will enable you to wrap about one inch of the

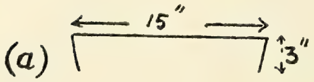
netting round the wire to make firm straight bottom edges to the trap.

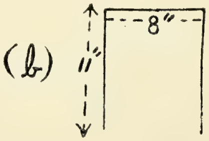


Stage 3. Holding the leading edge of the netting centrally, bend the wire so that you get an isosceles triangle with a base of approx. 3 ft. 8 inches. Bend the back edge of the netting so that you have an 8 inch square hole.



Stage 4. Bend two short lengths of the galvanized wire like this :

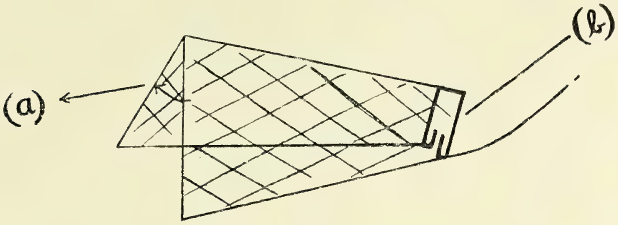




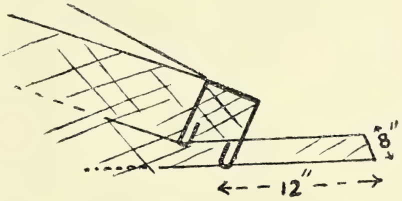
(*a*) holds the front of the trap together and provides the support for the main drop-gate, the short 3 inch ends being threaded into the mesh. Distance from apex approx. 9 inches.

(*b*) strengthens the rear hole by being threaded down the sides of the netting and bound along its top with binding wire.

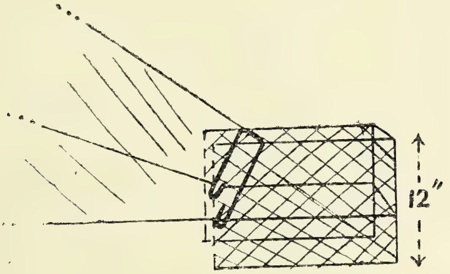
When (*b*) is in position, turn the 3 inches of protruding ends upwards and inwards. These projections form 'stops' for the door of the 'box' to fall against.



Stage 5. The protruding ends of the long wire should now be bent to form a firm bottom rim to the box, the two ends being soldered or bound together with binding-wire, any surplus being cut off.



Stage 6. To make the box, (*a*) take a 2 ft. 10 inch length of 1 ft. wide ½ inch mesh wire-netting and bend it so that it will form two sides 13 inches long with an 8 inch end. Fix its top edge on each side flush with the top of the rear hole of the trap and overlapping the sides of the trap so as to leave no space at the sides by the bottom of the trap hole: (*b*) fold the 6 inches or so of netting below the wire frame inward and underneath to form a bottom to the box, and bind the edges which overlap with binding-wire. There is no need to do any cutting. Also bind the forward edges to the trap netting. This forms a three sided box with an open top.



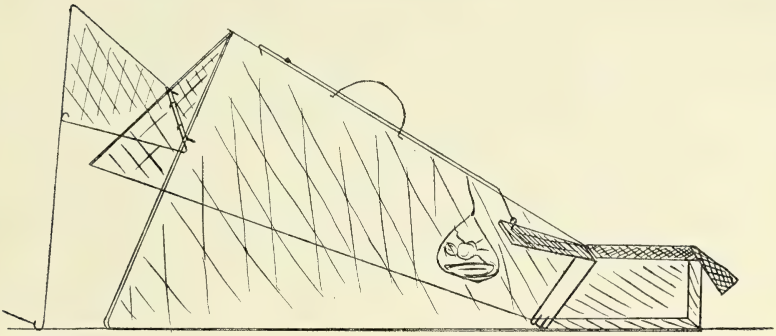
Stage 7. To close the top of the box, take a double strip of cloth approx. 9 inches by 12 inches (I cut off the bottom 12 inches of the leg of an old pair of grey flannel trousers). In the middle of the underneath layer cut a $4\frac{1}{2}$ inch circular hole. Stitch this layer to the rim of the box all the way round. The upper layer should also be stitched down except along the back edge. This enables the hand to be inserted between the layers and through the hole in order to extract trapped birds for ringing. The cloth should not be stretched tightly across the top; it should, in fact, sag a little otherwise difficulty will be experienced in getting the hand in and out. The last few inches of the open end will be found to fall over the back of the box, and may be caught in a loop of elastic tied round the end of the netting. This will ensure that strong birds, such as mynas, will not force their way out between the layers.

(I suggest this closing of the box be done last)

Stage 8. For the drop-door to the box, use a piece of board, 3-ply, or, as in our case, a sheet of asbestos-cement, measuring $7\frac{1}{2}$ inches square. Drill two holes near its top edge and hinge it with binding-wire to the top of the rear hole of the trap. Drill a hole, or screw in a hook, about an inch from its bottom edge to take a string passing through the top of the netting to the front of the trap, so that the door may be lowered or raised when the ringer is standing in front of the trap. Birds can then be driven very easily into the box.

Stage 9. To complete the front of the trap, (*a*) cut a triangular piece of netting an inch larger on all three sides than the area above the stay-wire. Fold the bottom edge round the stay-wire; bend over and bind the other two edges to the sides of the trap. (*b*) bend a length of the galvanized wire to form the frame of the drop-gate, so that the completed frame is longer at each side than it need be to close in the front by about 3 inches. In depth the bottom edge should be nearly flush with the ground. Cover this frame with a strip of the $\frac{1}{2}$ inch netting and hinge it to the stay-wire in two or three places with binding-wire. The advantage of the overlapping ends of the gate is that when the ground is slightly uneven a flush fit with the ground can often be attained by bending the sides of the trap slightly inwards or outwards.

The gate is best propped up by a rod. It may be hooked to a wire projecting from the apex of the trap, but its release from this is apt to result in the whole trap being moved. It is better to have the string attached to the bottom of the rod to eliminate movement in a wind. A sharp tug can then be used to release the gate without fear of pulling the drop, and quick birds like tits will then beat it and get have the rod too long. The gate requires to be held only a little above the horizontal, otherwise it takes too long to drop, and quick birds like tits will then beat it and get away, or be hit by it and possibly be injured. When food is hung up inside, it should be placed as near the rear as possible, just clear of the drop-door.



HAYBARN,
THURSLEY,
SURREY,
ENGLAND.
*September 22, 1955.*

R. S. P. BATES,
*Lieut.-Col.*, I.A. (Retd.)

## 14. FOOD OF THE RUDDY SHELDUCK, *CASARCA FERRUGINEA* (VROEG)

I see that on p. 238 of 'The Abominable Snowman Adventure' by R.W.B. Izzard, the author, after a meal of the Brahminy Duck, which he disliked, quotes Dr. B. Biswas's 'academic dissertation' to the effect that these ducks' diet is 'chiefly composed of dead bodies floating down the rivers of India'. Quite probably the author's leg was being gently pulled by Dr. Biswas (it was not the first tall story he had assimilated on this trip !). But it would be interesting to know on what field-observations, if any, this oft-repeated statement is based.

Few zoologists in the last 50 years support it. The most careful of all, C. B. Ticehurst, in 'Birds of Sind' (p. 444), wrote: 'The popular belief that it is a foul feeder is very largely exaggerated, if not entirely false—at any rate as regards Sind and the Punjab. Its chief food appears to be grass and I have found it quite eatable.' Blanford (Fauna of British India, IV, 428) describes the food as grass, mollusca and crustacea. 'The story that is told of its eating carrion is very improbable, but it may visit carcases in order to feed on insects.'

Stuart Baker (Indian Ducks and Their Allies, I, p. 148) after noting, as Oates did in Burma, how much they like 'clean, clear water' says they are 'almost omnivorous, including fish, flesh, grain, water-weeds, seed and growing crops. There can be little doubt that they sometimes fall so low as to take offal.'

Certainly the distribution of the Ruddy Shelduck in parts of Northern India and Burma is such that if their food is 'chiefly composed of dead bodies' they must go hungry over a great part of their range for two-thirds of the year. In many years' observation on the Irrawaddy and the Chindwin I never had occasion to suspect them of carrion-feeding, nor did Smythies who described the bird 'as in the main a vegetable feeder.' I put the story on a par with that of the carrion-feeding habits of the Burmese hare (*Lepus peguensis*) which was often repeated to me by sportsmen who had never attempted to dissect one in their lives.

The only field-observation against these which I can trace is in Meinertzhagen's 'Birds of Arabia' (p. 417) where after saying that their food 'is mainly green weeds . . . grain, crustacea . . . and small water molluscs' he adds: 'In Ladak I have seen them lopping up bits of a putrid horse, and on the Ganges near Delhi as many as twenty birds gorging on the much macerated corpse of a Hindu.'

The fact that their flesh is poor eating is not necessarily proof of depraved tastes as the Common Shelduck (*Tadorna tadorna* L.) is also very poor eating though it has never been accused of carrion-feeding. It must also be remembered that maggots from rabbits' guts are an attraction at times to three of our most highly-esteemed and edible game birds, the pheasant, the snipe and the mallard, in Great Britain, two of which eat a great deal of grain, grass etc.

It would be very interesting to know how far the old volumes of the journal of our Society support this story of carrion-eating in the Ruddy Shelduck. I have been unable so far to trace any reference, but my series is incomplete.

CONEYBURY HOUSE, J. K. STANFORD
WEST AMESBURY,
WILTS.
*September* 9, 1955.

[There are no records in the *Journal* to support the allegation. In reply to our request for details regarding his alleged statement concerning the food of the Ruddy Sheldrake, Dr. Biswas writes 'I most strongly deny ever making such a fantastic statement to Izzard, or for that matter to any other person, that the Ruddy Sheldrake's diet "is chiefly composed of dead bodies floating down the rivers of India". I have never seen such a thing, nor have I ever heard or read about it. Evidently Izzard's statement originated from some misunderstanding. Sometimes we used to talk about birds, and I might have mentioned birds that eat carrion in India. Unfortunately, the journalist in Izzard remembered the dead bodies (they have news value in England) but forgot the name of the bird!'—EDS.]

## 15. THE PYTHON'S FOOD

In the *Journal*, Vol. 21, p. 460-461, Major F. Wall writes of the food of the Python: 'The most curious meal that I have had reported to me was a double handful of earth-worms, and a handful of the berry called by natives Jaman. My informant was Mr. J. H. Mitchell, a planter in Assam'.

Mr. Ramesh Bedi, Gurukula Kangri, Hardwar, writes that a python kept in his house passed out fifty grains of wheat in its dung after swallowing a pigeon. The digestive juices of the python's stomach had no effect on the wheat while they had totally dissolved the pigeon's bones. Mr. Bedi pertinently suggests that Major Wall's record of the handful of berries found inside the python in Assam was in all probability the food of another animal which had been swallowed and digested by the python.

Bombay Natural History Society,
114 Apollo St.
*September* 15, 1955.

EDITORS

## 16. ANÆMIA CAUSING MORTALITY AMONG BROWN TROUT AT THE ACHHABAL FARM, KASHMIR

While carrying out certain faunistic investigations at the Achhabal Trout Farm, on the evening of the 27th July 1955, the Jamadar of the hatchery brought to me a dead Brown Trout to ascertain the cause of its mortality. The staff of the Farm is familiar with fungus, lipoid degeneration of the liver, Blindness and Fin Rot as diseases of the Farm trout, but the specimen under report did not show any of the usual symptoms of these diseases. Outwardly it appeared normal and healthy but when the gill cover was lifted the gills were found to be pale white. On opening the specimen the liver, the heart and all structures were found to be of a whitish pale colour, except the deranged ovaries which were of a yellowish-orange colour. The heart had a small quantity of reddish watery fluid. The stomach and the intestines were empty except a few inches towards the end which contained greenish faecal material. The eggs were small in size about mm. in diameter. No internal parasites were noticed. All these features indicated the extreme anæmic condition of the trout and death was attributed to anæmia.

The dead specimen was found floating near the outlet of Tank No. 19, in which 198 Brown Trout of 2-3 lb. in weight and 5-6 years of age are kept for breeding purposes. This tank is 53 ft. long, 6 ft. wide and 5 ft. deep. The depth of water in it is maintained at 3 ft. The specimen under report was not noticed when the fish in this tank were fed with fresh pieces of country fish about 45 minutes earlier. The dead specimen was 1′ 9″ long and weighed 3½ lb.

A second specimen, a male Brown Trout 15″ long and 1¼ lb. in weight, was brought to me about midday on the 28th. It showed no outward signs of any disease except that there were 3 broad black patches along the back. The gills were of a pale pink colour, the liver and heart were of a reddish colour, but all other organs had turned white except the gall-bladder. The stomach and the intestine were empty and no internal parasites were noticed.

This specimen had been picked up by a watcher from the bottom of Tank No. 17, where 210 Brown Trout of 1½ lb. to 2½ lb. are kept for breeding purposes. This tank is 44 ft. long and 8 ft. broad with a depth of 5 ft. but the depth of water is 3′-10″.

According to Davis[1] (p. 283) anæmic trout are not uncommon under hatchery conditions. Anæmia may be caused by lipoid degeneration of the liver or may result from heavy infection with animal parasites. Dietary deficiencies are also stated to be the main cause of anæmia. Underfeeding may also result in anæmia. To my mind, the cause of anæmia in the two fishes under report is underfeeding though they are daily fed on pieces of fresh country fish. Nearly 15 to 20 seers of country fish is given to over 1,000 fish ranging in weight from 12 oz. to 6 lb. Even for the largest fish of 6 lb. or over on an average the supply is less than 2 oz. per day. I think this is inadequate and therefore the weaker fish have to starve. The practice of feeding is that handfuls of fish-meat pieces are thrown in each tank where the healthy and more vigorous fish take more than their normal share while fishes suffering from general debility may remain underfed. If this is repeated day after day then the weaker fish in a tank have no chance to rehabilitate themselves and through underfeeding may become anæmic and die slowly and gradually while resting at the bottom. This practice of feeding needs serious consideration, for fishes suffering from general debility must be segregated and looked after properly in a separate tank. It follows from the above that the stock kept in the hatchery must be proportional to the food supply which should be calculated on some rational basis if the hatchery is to be run on economical principles.

This short note is published to elicit more information on this disease from other trout hatcheries in India and abroad.

ZOOLOGICAL SURVEY OF INDIA, SUNDER LAL HORA
CALCUTTA.
*August* 6, 1955.

## 17. OCCURRENCE OF THE EEL (*ANGUILLA BENGALENSIS*) IN SULEKERE RESERVOIR AND MARKANDEYA STREAM IN MYSORE STATE

On 22-9-1952, an adult eel measuring 44″ was hauled in a drag net in the Sulekere reservoir. Sulekere reservoir is in one of the Northern districts of Mysore state, constructed across one of the streams of the Thungabhadra river. The reservoir is on an elevation of 2,000 ft. and over 600 miles from the mouth of the Krishna River.

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[1] Davis, H. S. 1953. Culture and Diseases of Game Fishes (University of California Press; Berkeley and Los Angeles).

After the construction of the Thungabhadra dam, the migration of the eel from the sea to the upper reaches of the Thungabhadra is prevented. Consequently, in recent years, the eel fishery in Sulekere has disappeared. The adult eel is one of the many eels which will never get back to the sea to propagate.

On 17-4-1955, an 11″ advanced eel fingerling was caught in the Markandeya stream which is in the eastern part of Mysore State and in the Palar drainage system. During 1952-53, there were heavy rains and during the floods the eel fingerlings must have migrated up the Palar River. The stray occurrence of eels in the northern and eastern drainages of Mysore State in recent years is of significance.

FISHERIES SECTION,
DEPARTMENT OF ANIMAL
HUSBANDRY SERVICES
IN MYSORE, BANGALORE.
*June* 25, 1955.

H. D. R. IYENGAR
K. VENKATESH
D. R. KRISHNA MURTHY

## 18. THE *THATTA-KHONDAA*—A SCREEN TRAP OF THE CHILKA LAKE

(*With a diagram*)

Trapping was probably the earliest method that man tried for capturing fish, long before other tackle like nets was used. It is indeed a simple as well as an effective method since most traps, being fixed, do not require constant attention by the operator. They can be left to themselves to function, while the operator is engaged elsewhere.

Fishing gear of the Chilka Lake, including traps have been described by Devasundaram (1951 and 1954), Jones and Sujansingani (1952 and 1954) and Job and Pantulu (1953) in fair detail. The Fish-marketing Reports of the Government of India (1941 and 1946) and Mitra (1946) also mention briefly a few varieties of fishing tackle operated in the Lake. A method of fish trapping with bamboo screens set in a particular way to form a trap was observed by the author during the survey of the fisheries of the Lake. This method does not appear to have been recorded in any of the above reports.

The operators of the screen traps described in this note are Kandaras and Kartias, the latter being a minor fisherman caste confined to a few of the many fishermen's villages scattered in and around the Chilka Lake. Kandaras, who form the second largest fisherman community of the Chilka area, are 14·3% of the total population (Mitra and Mohapatra, unpublished). The fishermen of Barrokudi and Baghananji, two Kartia villages situated on the northern shore of the lake and many of the Kandara villages of the south western shores have been observed to operate such traps in their localities.

### BAMBOO SCREENS. THATTA

Several small bamboo screens, varying from 20 feet to 30 feet in length and from 4 feet to 6 feet in height are joined together to form a trap. Each screen is made of small bamboo pieces, measuring ¼ inch to

½ inch in width and of the above height, are tied to each other with jute, hemp or 'noi' strings along the upper and lower margins, as well as at regular intervals. Such bamboo screens are termed *thattas* in Oriya, and cost about Rs. 10 each. The thattas are either made by the fishermen themselves or purchased from neighbouring villages.

### THE SCREEN TRAP. THATTA-KHONDAA

The diagram shows the ground plan (i.e. as seen from above) of the different screens in such a trap, which is known locally as *Thatta-khondaa*.

A long screen or leader line, *a* forming a sort of barricade is set up at about right angles from the shore. This screen extends for a distance of about 50 feet into the lake, the length varying in different sets, and finally terminates at *c*. On both sides of this terminus are fixed two screens, *b*, functioning as secondary leader lines. The proximal ends of these screens set about a foot beyond the end *c* are folded opposite each other at *d*, leaving a small passage of about 2 to 3 inches' width between each. The other ends of these secondary screens which are set like two arms of V, at acute angles to the long screen, diverge and extending towards the end, terminate at a distance of about 10 to 15 feet from the foldings *d*. The gap between the long screen and the terminus of such a secondary leader line may vary from 5 feet to 8 feet in different traps.

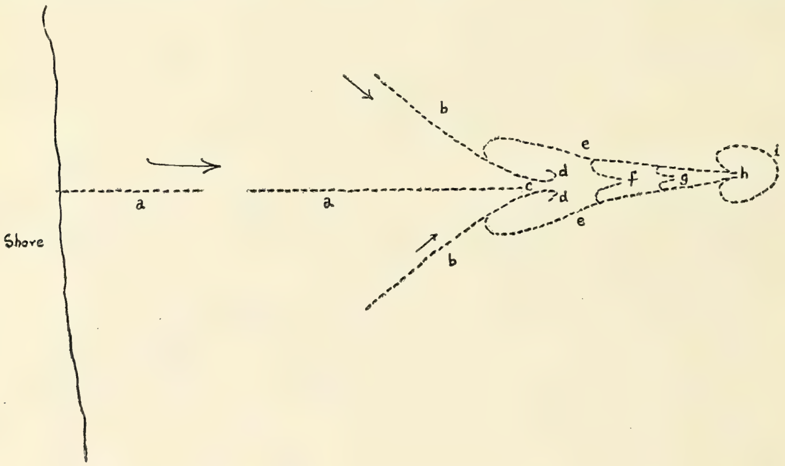

Diagram showing ground plan of a typical Screen Trap.

Two outer screens, *e*, are fixed on both sides to cover the main length of the trap. The shore-ends of these screens are curved inwards, and are attached to the outer walls of the secondary screens, about one and a half feet from the foldings *d*, while the other ends tapering forward terminate without any curves, leaving a small gap at *h*, measuring about an inch between the two extremities of the right and left outer screens. This portion is finally encircled by another screen *i*, forming an enclosed cylindrical cavity open at one side, which may be termed the trap-chamber. The extremities of the screen forming the chamber are attached to the outer faces of the screens *e*, *e* about a foot behind the extremities *h*. The efficiency of the trap is further increased by two pairs of additional screens (*f* and *g*), which serve as valves. The free ends of the valve screens point towards the trap chamber, leaving small vertical openings for the one-sided passage of fish. The other ends are curved and attached to the inner faces of the outer screens.

All the bamboo screens, which are fixed vertically, are supported at short intervals of 3 feet to 4 feet by stout bamboo poles. The average length of such a screen trap, excluding the long screen or leader line, usually varies from 15 feet to 20 feet. In many instances, a trap may be extended further towards the lake, by fixing a new secondary leader line from the outer extremity of the trap-chamber of the original trap. This new leader line ultimately leads to another trap set 20 feet to 30 feet away.

### WORKING OF THE TRAP

The fish and prawns that strike the leader line or the inner sides of the secondary leader lines follow these lines and enter into the trap. Once they get into the trap-chamber, it is difficult for them to escape. The operator visits his trap in his dug-out and empties the catch at short intervals. A four-pronged iron spear, termed *Tenta* in Oriya, is usually used by the fishermen to find out if any fish has been trapped.

Prawns, cat-fishes, mullets, and other medium and small size fish are usually captured in these screen traps, which are fixed practically throughout the year.

The author is indebted to Sri G. N. Mitra, Director of Fisheries, Orissa for his kind interest during the survey tour. Thanks are due to Sri B. C. Das, Inspector of Fisheries, Kuhuri, for assistance.

MARINE SECTION,
DEPT. OF FISHERIES, ORISSA, P. MOHAPATRA
BALUGAON.
*August* 15, 1955.

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## 19. GROUP FISHING WITH CAST NETS IN THE CHILKA LAKE[1]

Cast nets, which are common to the local fishermen, are operated by whirling them round the head like a lasso. A small loop at the apex is held by the operator while casting the net into water. The bottom is weighed down by over 200 lead rings, and a bag is formed along the circumference by raising the lead line by about six inches with the string passing through the lead and a row of mesh about 1½ feet from the bottom line. The weight of the lead drags the bottom to the ground enclosing all the fish in that area. The height of the cast net varies from 10 to 20 feet and the circumference from 35 to 90 feet. The mesh may vary from ¾ inch to 2 inches depending on the types of fish to be caught.

Devasundaram (1951) in his paper on the 'Fishing Methods for Chilka Mullets', published in *Indian Farming*, Vol. 12, No. 1–2, describes a method where seven to ten boats with 15 to 20 fishermen take part in group fishing. Here the boats diverge in a circle, and then converge towards each other casting their nets simultaneously, so that most of the fish in the locality are captured.

A different form of use of larger cast nets has also been observed along the western shores, where 5 to 10 nets are operated by 15 to 20 fishermen. The nets are spread in an acute angle from the shore and the peripheral ends of the connecting nets are held together. The heavy lead rings make the lower portion of the net touch the bottom, while the portion above the water line is stretched open by the fishermen. One fisherman is usually made to hold the ends of two connecting nets. Other fishermen moving about in boats drive fish towards the nets. As soon as the fish enter the area, the ends held by the fishermen are allowed to fall, and all the fish within the nets are captured.

Similar group fishing with drag nets instead of cast nets is also prevalent in the Chilka lake.

MARINE SECTION,
DEPARTMENT OF FISHERIES, P. MOHAPATRA
ORISSA, BALUGAON.
*September* 22, 1955.

## 20. ADDITIONAL INFORMATION ON THE *MANI-JAL* OF THE CHILKA LAKE[2]

Jones and Sujansingani have described the *Mani-jal* on p. 288 of *JBNHS*, 51 (1)—December 1952. This light surface drag net made up of a series of bags is specially devised to catch the gar fish (*Tylosurus strongylurus*), and the half-beak (*Hemirhamphus gaimardi*), locally known as Gania and Saragara respectively.

The above authors have stated that the use of this net is restricted to within a few miles distance of Chandraput village, and that though it has been in existence for generations it has not been copied elsewhere on the vast lake which spreads over an area of 400 square miles. From a recent survey of the fishing villages of the Chilka area, it has been observed that the net is also used by the Keuto fishermen of Pathara village situated about 5 miles south of Chandraput. Statistical reports show that the fishermen of Chandraput possess 377 such nets, and those of Pathara 51 nets. The *Mani-jal* which is pronounced correctly as *Muni-jalo* is also known as *Gania-jalo* (from Gania the Oriya name of *H. gaimardi*).

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[1] & [2] Published with the kind permission of the Director of Fisheries, Orissa.

MARINE SECTION,
DEPARTMENT OF FISHERIES, P. MOHAPATRA
ORISSA, BALUGAON.
*August* 26, 1955.

## 21. THE CAST NET

In the course of the preparation of a monograph on the world distribution of the cast net (Sanskrit *jāla*, Arabic *shabaket*, Indian continent *khebla jal, khepa jalo, sounki jal, wesi dela, vichcha valai, vichu vala* etc.) in its different forms, I have been unable to obtain any reliable information regarding the following areas: Tigris, Euphrates and Persian Gulf; Iran; Afghanistan; Baluchistan; those areas of U. S. S. R. and Tibet north of Afghanistan and the Himalayas. In contrast, the occurrence of the cast net in the Indian sub-continent is well documented.

I would welcome records, either first-hand accounts or references to literature, from these areas, and particularly wish to know the local names of the net, and the type of cast net. There are three types of cast net, all represented in India and Pakistan. The simplest is a cone of netting with a weighted circumference used mainly in inland hill-streams. The second and most widespread has the circumference tucked up a few inches and tied to the net at intervals, while the third has an apical hole through which the throwing cord runs; this cord splits up into a number of radial cords running to the lead line. This last, the true pursing cast net, is recorded in the Indus delta, and on the Malabar and Coramandel coast.

A peculiar type is recorded from the Gujarat area (Agricultural Marketing in India. Preliminary Guide to Indian fish, fisheries, methods of fishing and curing. Marketing Series, No. 24, Delhi, 1941). It is called *mang*, and is 35 ft. long by 7 ft. deep, of ¼ in. mesh. 6–9 pieces are linked together and *thrown by hand* to form a semi-circular enclosure. If the description is indeed of the cast net, and not of an ordinary perpendicular set or wall net, the matter is of extreme interest, as rectangular cast nets are otherwise only known from Samoa and the Solomon Islands, in the Pacific. I would be glad to have this observation confirmed.

FISHERIES OFFICE,
P. O. 72, LUSAKA, P. I. R. MACLAREN
NORTHERN RHODESIA.
*March* 7, 1955.

## 22. A TANK-FISH MALADY

Here at Lucknow on 20th January 1955, after a night shower, it had suddenly become very chilly and foggy in the morning; and in an old tank nearby known as Suraj Kund it was observed that the fishes were floating briskly at the surface of the water since the very early hours say 4 a.m. The fishes were of normal size, about 1½ ft. to 2 ft. in length. Smaller fishes were also present. People seeing this got into the tank armed with sticks and killed fishes in hundreds. Some persons even collected as many as two full gunny bags within 10 to 15 minutes and left the place with a good harvest. The killing of fishes by sticks lasted for more than six or seven hours, and to witness this a huge crowd had assembled round the tank.

The tank about 150′ × 160′ is now almost katcha, as all the old small brick walls have fallen in and only at a few places pucca structures such as the steps remain, giving it an irregular shape.

The average depth of water in it is 8 to 10 feet. The tank as usual has some algae and mosses attached to its sides. It also gets dust and pieces of old leaves and newspaper with other organic matter by wind from the neighbourhood. The tank is not connected with any outside source of water and whatever water it gets is from the rains. Nor does it get any jaggery thrown in as in the South. This condition requires the attention of experts as such sudden losses of fish from tanks can affect considerably the fish industry of a State. The local people have only one explanation to give and that is somebody must have poisoned the water. If so, however, no fish should have remained while now hobby fish catchers have started to visit the place again.

NATIONAL BOTANICAL GARDENS,
LUCKNOW.
*March* 1955

V. CHANDRA, M.SC. (BOT.)
*Senior Scientific Asst.*

[Dr. C. V. Kulkarni, Director of Fisheries, Bombay, comments on the above as follows :

' The author mentions that the day was foggy and chilly. On account of lack of sunshine the photosynthetic activity of the green algae resulting in carbon assimilation is reduced, with the result that the liberation of oxygen does not take place sufficiently. At night when the photosynthetic activity is nil, there is more accumulation of carbon dioxide at the bottom and depletion of oxygen. Many times the condition is accentuated by accumulation of other putrefying debris at the bottom. The cumulative effect of these conditions results in considerable increase of the carbon dioxide tension in the water adjoining the bottom of tanks. The fish, therefore, approach the surface to obtain oxygenated water and in some cases actually gulp in surface water. It is at this time that the fish are exposed and are attacked by people. Such instances have been recorded on many occasions '.—EDS.]

## 23. BUTTERFLIES OF BOMBAY AND SALSETTE—ADDITIONS

With reference to my list published in your *Journal*, Vol. 50, No. 2 of December 1951, I had another spell in Bombay from April 1952 to January 1953, during which I was able to spend more time in the north-eastern and central portions of the Island, as a result of which I have to record five more species of Lycaenidae, and also a Pierid and Danaid not previously noted by me. I also give additional notes on a few other species, as under:

**Papilio helenus dakhsha**

Several seen and taken in the hills behind Ghodbunder in August and September. These were not reported by me in the previous list though Mr. Alfrey's footnote recorded that he had seen them. They are by no means common.

**Papilio polymnestor polymnestor**

Two more seen on the path between Tulsi Lake and Kanheri Caves. This species must be very scarce on the island.

**Colotis danae**

One male taken in May in the low scrub jungle-clad hill near Marve beach, and another seen.

**Euploea crassa kollari**

Several at Tulsi Lake in August and at Powai Lake in September.

**Lethe rohria nilgiriensis**

This occurs commonly from June to September in the bamboo forests on the path between Thana and Ghodbunder.

**Euthalia lubentina lubentina**

Three males observed on three successive Sundays during September and October at the highest point of the range of hills immediately north of Kanheri caves.

**Kallima philarchus horsfieldii**

A number seen singly at various places on the path from Tulsi lake to Kanheri and on the path from Thana to Ghodbunder.

**Tarucus nara**

Two on hill-top to the east of Tulsi lake.

**Zezius chrysomallis**

A ♀ taken near the bund on Vihar Lake early July and a ♂ seen but missed the same day and place. Not seen elsewhere.

**Tajuria jehana**

A single ♂ taken at the north end of Powai lake in August. There were others out of reach on the same mango tree.

**Virachola isocrates**

Several in the hills behind Ghodbunder, also at Powai and Tulsi lakes. This is quite common.

**Rathinda amor**

Quite common near Ghodbunder in July and August.

**Syntarucus plinius**

Several taken on path between Tulsi and Kanheri in July.

**Spalgis epius**

Fairly common at the Thana end on the path between Thana and Ghodbunder in July and August.

**Horsfieldia anita anita**

This is quite common in the hills behind Ghodbunder from August to October.

6, LYONS RANGE,
CALCUTTA. A. E. G. BEST
*June* 17, 1955.

## 24. GENITALIA, AND REPRODUCTIVE ORGANS OF *MONANTHIA GLOBULIFERA* WLK. (HEMIPTERA—TINGIDAE)

(*With a plate*)

### INTRODUCTION

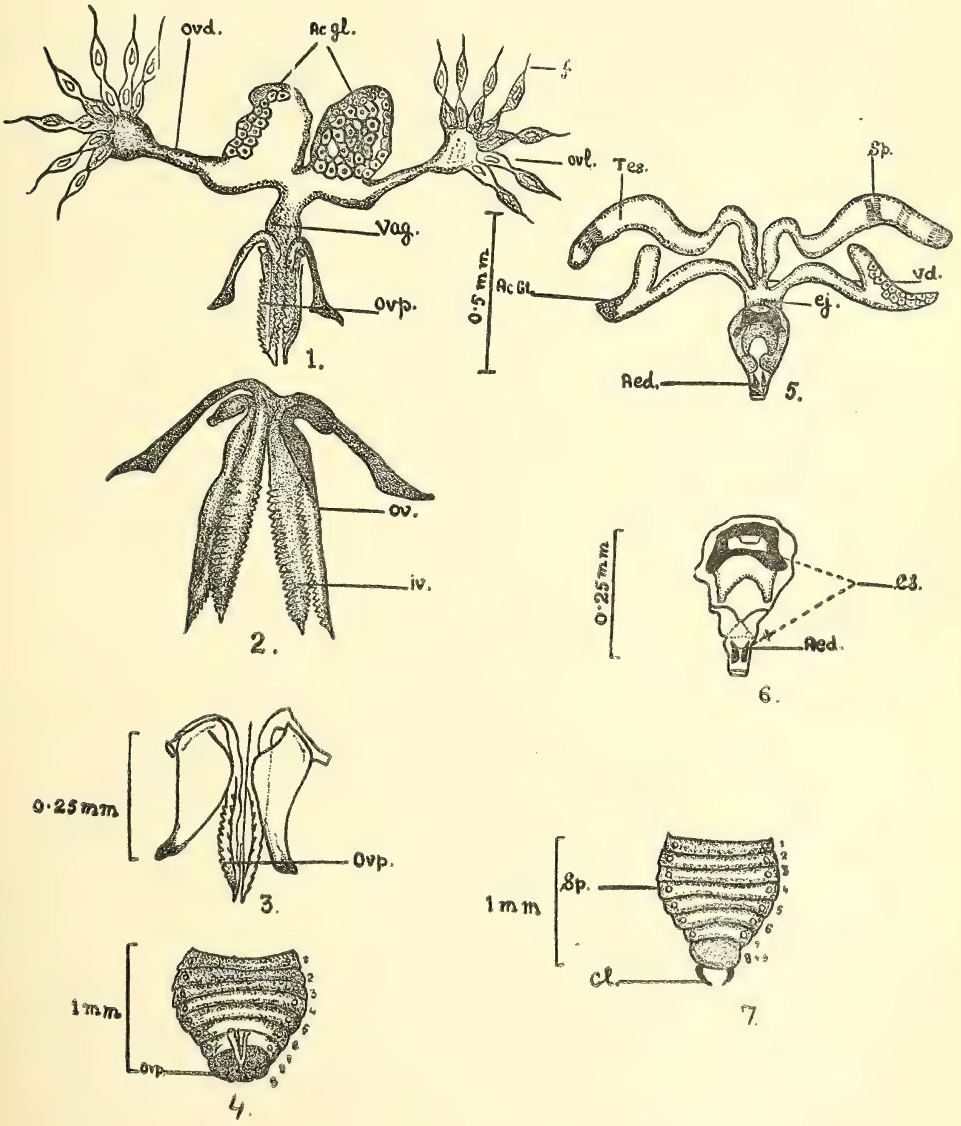
The internal anatomy of Tingid bugs has not been at all studied. This appears to be due to their small size and possibly they are obscure insects found rarely in common field collections of crop insects. *Monanthia globulifera* Wlk. is the common Tingid bug found on different species of *Ocimum* and *Mentha* plants throughout India. The description of genitalia and reproductive organs of this species would thus be a representative description of the structures found in other Tingid bugs and this would form a basis for comparison with the structural variations found in other species.

Male Genitalia. (Figs. 5 and 6)

The ejaculatory duct (eg) opens in a large bulbous chitinous structure (fig. 4). This bulbous chitinous structure appears to be composed of three regions, namely the posterior part, the middle bulbous part and the anterior tubular part. The anterior tubular chitinous part forms the aedeagus (Aed). The wall of the aedeagus is provided with a pair of thick chitinous sclerites situated about the middle of the tube. Posterior to the aedeagus there is a pair of chitinous wing-like structures (fig. 4 (2)). The posterior part is a large swollen bulb-like structure into which opens the ejaculatory duct. This is provided with a thick chitinous sclerite (Cs). The external genital structures consist of a pair of pincer-like chitinous structures (cl) arising at the terminal segment which is the fused 8th and 9th abdominal segment. These claspers are used for clasping the female during copulation (fig. 7).

Female genitalia. (Fig. 2).

The female genitalia consist of two pairs of valves arising from 7th and 8th abdominal sternites of the female abdomen (fig. 3.). The ovipositor is a pointed bristle-like somewhat conical structure consisting of a pair of outer valves and a pair of inner valves. The inner valves are flat and end in a needle-like point terminally. The dorsal and ventral edges are provided with serrations (fig. 2). These serrations arise from the very tip and are continued up to four-fifth of the valve. These valves are


Ovd.
Ac gl.
ovl.
Vag.
Ovp.
1.
0·5 mm
Tes.
Sp.
vd.
Ac Gl.
ej.
Red.
5.
ov.
iv.
2.
0·25 mm
es.
Red.
6.
0·25 mm
Ovp.
3.
1 mm
Sp.
1
2
3
4
5
6
7
8+9
cl.
7.
1 mm
Ovp.
4.

Genitalia and Reproductive Organs of *Monanthia globulifera* Wlk.
(*For explanation see text*)

closely fitted in the inner groove-like depressions of the outer valves. Transverse lines are also visible between the serrations in these valves. Posteriorly the valves are continued as thick rod-like powerful chitinous structures which are curved downward. The outer valves are smooth on the dorsal edge and possess serrations on the ventral side only. These have groove-like depressions on the inner surface into which the inner valves are fitted. All the two pairs of valves of each side are close to each other and lie hidden underneath the abdomen. The valves form a drill-like structure for making slits in the tender stems of the host plants. After the slit has been made the ovipositor works also as a guide for the deposit of eggs (figs. 1, 2, 3, and 4).

Male reproductive organs. (Fig. 5.)

The male reproductive organs consist of paired testes (Tes), paired vasa deferentia (Vd), paired accessory glands (Acgl), an ejaculatory duct (eg), and the intromittent organs or aedeagus (Aed). The testes are long tubular structures lying on the sides of the alimentary canal and reach up to the second abdominal segment. The testes open into a small canal which is the only indication of vasa deferentia. The paired accessory glands are closely applied to the sides of testes as can be seen in fresh dissection. These accessory glands are bifurcated into two small arms at the distal blind ends. The accessory glands open into the bulbous part of the ejaculatory duct at the junction where the common duct formed by the joining of each vas deferens also opens. The accessory glands have cellular structures with prominent nuclei. The ejaculatory duct leads into the chitinous aedeagus. The spermatozoa are long, thread-like in form and can be even seen in unstained specimens vibrating in the tubular testes.

Female reproductive organs. (Fig. 1)

The female reproductive organs consist of a pair of ovaries, oviduct (Ovd), a pair of accessory glands (Acgl) and the vagina (Vag). The ovary consists of 14 ovarioles of acrotrophic type divided into 7 ovarioles on each side. Each ovariole is an elongate tube with several oocytes when mature and few oocytes when immature. Each ovariole ends in a terminal filament and the filaments of 7 ovarioles of one side unite together to form a common filament and finally the two common filaments of each side of 7 ovarioles unite to form a common median filament. This is attached anteriorly to the intestine which keeps the ovary lying dorso-laterally to the alimentary canal. When the ovary is mature it reaches up to the thoracic region. Posteriorly each ovariole opens into a common oviduct. The two oviducts are enlarged posteriorly at the place where they meet the two accessory glands. The vagina is formed at the junction where two sac-like structures called accessory glands open into the dorsal wall of the vagina. The accessory glands are large, prominent and sac-like structures and show prominent nuclei when stained. The accessory glands are concerned with the secretion of a fluid which after egg laying is discharged by the female in the plant tissue slits for gluing the eggs. The vagina leads into the ovipositor (Ovp) which guides the eggs for deposition in the slits made by the saw-like paired ovipositor. No spermatheca is visible.

AGRICULTURAL COLLEGE,
KANPUR.

U. S. SHARGA.
M.Sc., Ph D. (Edin.).

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## 25. LIVING CREEPER OR NWE-SHIN

Subsequent to his note in the *Journal* (Vol. 52 : 566) Mr. H. G. Hundley sent in specimens of the Living Creeper or Nwe-Shin. These have been identified at the Indian Museum as *Gordius fulgar* Baird. This worm belongs to the Phylum Nemathelmenthes which includes Round and Threadworms. The genus *Gordius* passes through three distinct stages of which the first two are larval and parasitic. In the third or adult stage, it is a greatly elongated thread-like worm which lives in or near water.

BOMBAY NATURAL HISTORY SOCIETY,
114, APOLLO STREET. EDITORS
*July* 28, 1955.

## 26. OBSTRUCTION IN A FOWL'S STOMACH

Once a large domestic cock was provided with balls of 'Ātta' one of which had an anna coin and another a two pice coin embedded within. The cock swallowed them readily. As it did not show any ill effects up till ten days later, it was thought that both the coins had duly passed out with the fæces. Three months later the cock was killed for the table. The stomach was examined to ascertain if the coins were still in it. To our astonishment both the coins were found lying at the pyloric end of the stomach. The coins had been partially affected by the gastric juice; all the markings from them had vanished and their thickness was also reduced. On cooking, the bird was found to have a strong metallic flavour.

It was a lucky coincidence for the cock that the coins caused no obstruction of the pyloric, which must certainly have resulted in its death.

DEPT. OF ZOOLOGY, ISHWAR PRAKASH.
JASWANT COLLEGE, S. C. SHARMA.
JODHPUR.
*September* 1, 1955.

## 27. DEPREDATIONS OF THE GIANT AFRICAN LAND SNAIL, *ACHATINA FULICA* (FERUSSAC) IN BALASORE (ORISSA)

The Giant African Land Snail, *Achatina fulica* (Ferussac), a native of East Africa, has spread by means of human agency to nearly all countries in the tropical and sub-tropical lands of the Indo-Pacific region during the last decade and a half (Ray, 1943; Rees, 1950). It has become a great pest of gardens, vegetable fields and rubber, tea and coffee plantations in all countries where it has got introduced (Jutting, 1934; Rees, 1950). Hence, during recent years, it has drawn the attention of various workers in different countries, e.g., Allan (1949), Rees (1950), Williams (1953) and many others. However, little is known about its status and habits in India.

The migration of *A. fulica* from East Africa to India through human agency dates back to 1847 when Benson carried living specimens from Mauritius to Calcutta where they were naturalised (Ray, 1943). Although Hornell (1951[1]) reported that *A. fulica* was confined to Bengal and had failed to spread elsewhere in India, Dr. H. C. Ray of the Zoological Survey of India, Calcutta, reported (*in litt.*) that it had spread to Bihar, Orissa and Nagpur.

Practically nothing was known about the spread of this snail to Orissa until it appeared in the form of an epidemic in the town of Balasore for three consecutive years from 1946–1948. During this period, the local Municipality, aided by the Government of Orissa, spent Rs. 1,900 for the control of this pest and it is estimated that 6,000 kerosene tin-fulls of all stages of *A. fulica* were collected and destroyed. The pest is believed to have entered Orissa at Amarda in Balasore district in 1939 from the adjoining district of Midnapore in West Bengal. In the State of Orissa *Achatina* is so far confined to the Balasore district where it continues to be a major pest of vegetable gardens, especially during the rains.

### General Habits

With the advent of the rainy season, *A. fulica* come out of their hiding places and are active till the end of winter after which they take cover. They aestivate during the dry summer weather. They breed during the rainy season and the various stages of the snail are found from July to September. The snail being very prolific gives rise to large populations, almost in an epidemic form, thus becoming a pest to agricultural fields.

The Giant Land Snail, as the name implies, lives on land and avoids water. During the rains, as water enters the sheltered habitats of the snails, they come out. When thrown into deep water, they get drowned. This is more effective during winter.

The snails are very voracious. They eat up almost all types of garden crops during the rainy season and winter. Their favourite food-plants are cabbage, cauliflower, pumpkin and various types of leafy vegetables. Bigger trees are not attacked.

*A. fulica* is nocturnal in habit. During the night, when they forage about, they move along the pathways and roads. During the years of epidemic, 1946–48, they literally covered the roads and pathways of Balasore town after dark. At daybreak they take cover in crevices, under stones, and decaying leaves. They also rest on the trunks of trees up to a height of about 6 to 7 feet. While foraging and taking cover, the snails sometimes enter dwelling houses.

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[1] Although published in 1951, Hornell's MSS was received by the Society at least 2 years earlier, i.e., before the Second World War started.—Eds.

The local aboriginal people of Balasore, the Santals who hail from the neighbouring hilly areas, although they take other species of snails, do not use *Achatina* as an article of food. Also its economic uses are unknown in the locality.

ACKNOWLEDGEMENTS

The author's best thanks are due to Sri P. N. Mahanti, I.A.S., District Magistrate, Balasore (now Special Officer, Home Department, Orissa Secretariat) for much valuable information incorporated in the body of the note and to Dr. H. C. Ray, Zoological Survey of India for invaluable advice and a list of references. Thanks are also due to Sri G. C. Sengupta, State Entomologist, Government of Orissa; Sri U. C. Panda, Lecturer in Zoology, Fakir Mohan College, Balasore; the Bombay Natural History Society and Sri B. C. Das, Principal, Ravenshaw College, Cuttack for their kind collaboration and the Director, Zoological Survey of India for the loan of literature.

DEPARTMENT OF ZOOLOGY,
RAVENSHAW COLLEGE,
CUTTACK (ORISSA.).
*March* 28, 1955.

BASANTA KUMAR BEHURA

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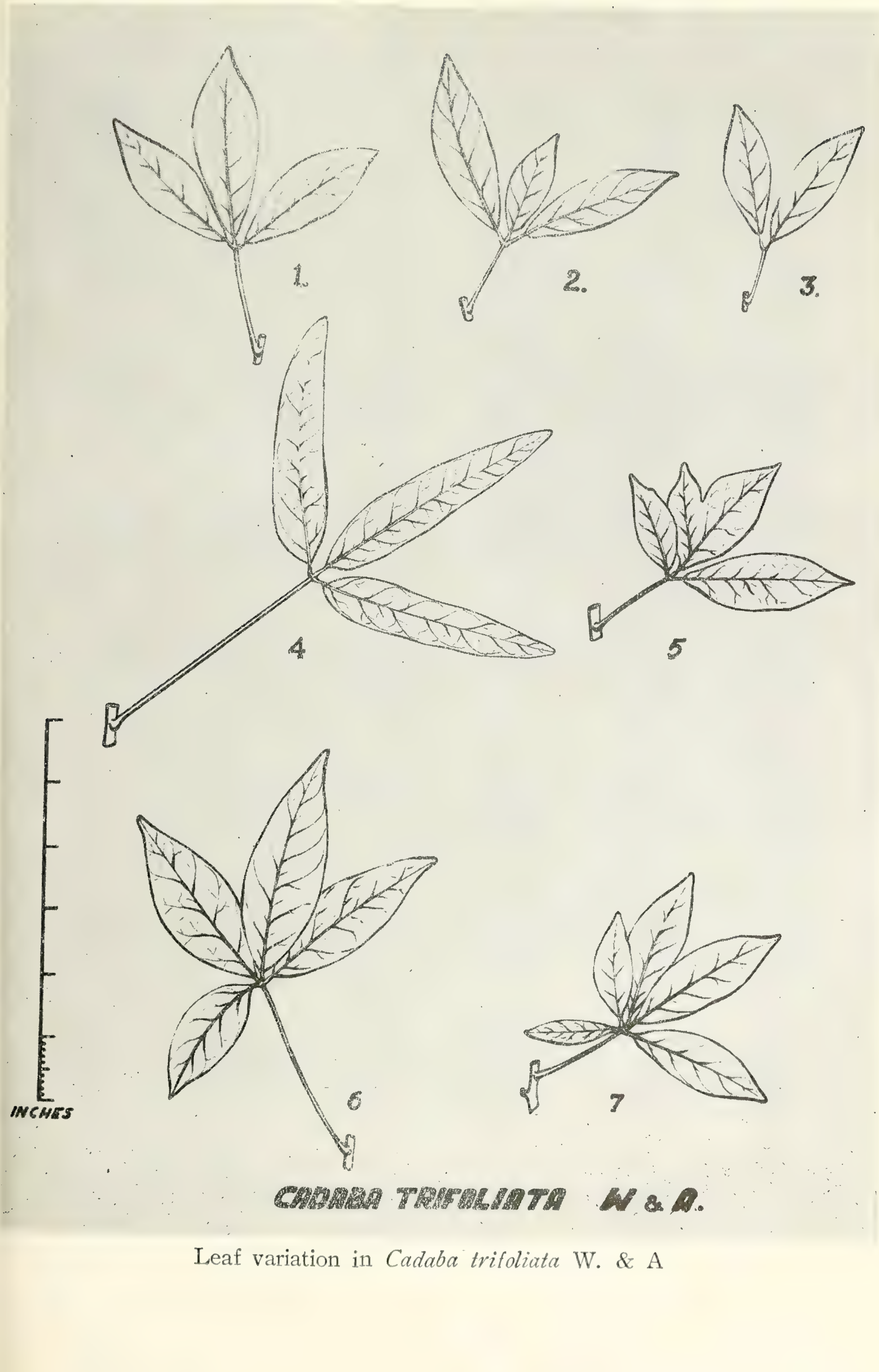
## 28. LEAF VARIATION WITHIN A SPECIES—*CADABA TRIFOLIATA* W. & A.

(*With a plate*)

In the course of examining the herbarium sheets of *Cadaba trifoliata* W. & A. (Capparidaceae) in the Madras Herbarium, an unusually high degree of variation was noticed in the number of leaflets in this species, and their shapes. The variation was remarkable not only by its existence in the same species but in its occurrence in different parts of individual plants also. There are instances of the occurrence of variation in the leaf shape due to varied edaphic conditions under which a particular


1.
2.
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INCHES
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7
CADABA TRIFOLIATA W. & A.

Leaf variation in *Cadaba trifoliata* W. & A

species happens to be distributed. It was interesting to observe the variations in the same branch, and a single sheet exhibited as many as three variations. All the specimens examined were collected in Tinnevelly District of S. India. The variations did not occur infrequently but were noticed in most of the sheets.

The variations in leaflet number and their shape differed considerably from the description given in the floras to identify the species. The species, as the name suggests, has normally palmately trifoliate leaves (Hooker and Gamble). The seven variations can be described as follows and the Herbarium sheet numbers are indicated as M.H.

1. Palmately trifoliate, central leaflet bigger, oblong-lanceolate leaflets, 3–4 inches long with a petiole 1½–2 inches long (M.H. 1491).
2. Palmately trifoliate, central leaflet nearly reduced to half the length of the accompanying leaflets on the sides; petiole 1½ inches long (M.H. 1489).
3. Bifoliate leaf with one inch petiole. Leaflets oblong-lanceolate, 2–2½ inches long (M.H. 1503).
4. Palmately trifoliate leaflets 4 inches long, lanceolate with a long petiole as much in length as the leaflets (M.H. 1487).
5. Palmately trifoliate with a tendency in one of the leaflets to show forking to one third or half its length (M.H. 1491).
6. Quadrifoliate leaflets 3–4 inches in length, starting from the same point. Leaflets oblong-lanceolate with a petiole attaining a length of three inches (M.H. 1491),
7. Pentafoliate, the leaflets varying in shape and size and arising from the same point; petiole shorter, up to 1½ inches (M.H. 1495).

The venation was uniform in all the variations. These variations, however, serve to emphasize the necessity of making a full study of the range of variability of leaves and other plant organs, and indicating the limits of variation in any species, before the appropriate descriptions are incorporated in the regional Floras.

AGRICULTURAL COLLEGE & RESEARCH INSTITUTE,
COIMBATORE. J. SAKHARAM RAO.
*May* 25, 1955.

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## 29. A NEW SPECIES OF *MARSILEA* FROM AJMER, INDIA

(*With three plates*)

After the discovery of *Marsilea aegyptiaca* in Jodhpur (Gupta, 1955)[1] efforts were continued to collect as many species of the genus as are available in Rajasthan, including the centrally situated small state of Ajmer, for the purpose of a detailed systematic study of the Indian species of *Marsilea*. While some investigations on the ecology and morphology of the *M. aegyptiaca* were in progress, some material resembling it was collected in Ajmer. The latter was sent to Kew for examination and was found to be identical with *M. aegyptiaca* by Mr. F. Ballard. Cursory examination of the anatomy of its sporocarps by the author, however, created some doubt about the identity of the two materials, namely *M. aegyptiaca* of Jodhpur and Ajmer respectively.

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[1] Gupta, K. M. (1955) : On the occurrence of *M.aegyptiaca* in Jodhpur, Rajasthan, India. *JBNHS*, **52**, (4), April 1955.

Gupta, K. M. & Bhardwaja, T. N. : 'On the Investigation of Indian Marsileas : their morphology and systematics.'

1. *Marsilea aegyptiaca* Willd. with remarks on the present systematic position of the Indian species (in press).

Further material was therefore collected and grown in flower pots in the botanical garden of Jaswant College and subjected to a detailed comparative systematic study, particularly with reference to the three other Indian species : *M. aegyptiaca* from Jodhpur, *M. condensata* from Sind, and *M. quadrifolia* from Ajmer and other places in Rajasthan for the following reasons :

(*a*) *Marsilea aegyptiaca* and Ajmer material had been considered identical by Mr. F. Ballard, the expert Pteridologist at Kew.

(*b*) *M. condensata* which occurs in the neighbourhood of Rajasthan in Sind also resembled *M. aegyptiaca* in some important respects.

(*c*) *M. quadrifolia* was growing in very close association with the new species at Ajmer and resembled it in some respects.

As a result of this examination and comparison, I am convinced that the Ajmer material is quite distinct from these or any other Indian species. A few important characters that might form the basis of classification of the various species of *Marsilea* in the future have been tabulated below with reference to only the three species with which we are concerned at the moment. Plates I-III illustrate the specific identity of the species.

It is quite clear from the study of the characters briefly enumerated above that the Ajmer material differs from *M. quadrifolia* in its relation of the pedicel to petiole, pedicel to pedicel, shape and outline of the sporocarps, attachment of the pedicel to sporocarp, number and nature of horns, and the number of sori in the sporocarps. Similarily it differs from *M. condensata* in the shape and size of the sporocarp, nature of the horn, number of sori, etc. In the same way it is distinct from *M. aegyptiaca* in the disposition of the sporocarps (always single in *M. aegyptiaca* and one or more, i.e., slightly connate in the new species), size and shape of the sporocarp, nature of the horn, number of sori, etc. My examination reveals that the new species seems to combine characters of more than one species and particularly *M. aegyptiaca* and *M. quadrifolia.* I wonder whether this new species is a sort of hybrid between these two latter species of *Marsilea* that are found in Ajmer. The material is being subjected to cytological and other types of examination by research students in my laboratory and it is hoped to clarify the position in the near future. It may not be out of place to mention that a study of an abnormal type of *Marsilea* to be described as a new species, *M. abnormalis* (in MS.) by Prof. P. N. Mehra and his students at Amritsar has shown that their material may be a hybrid. It may be noted that the latter produces only abnormal type of sporocarps (Mehra, 1938)*. The Ajmer material, how-

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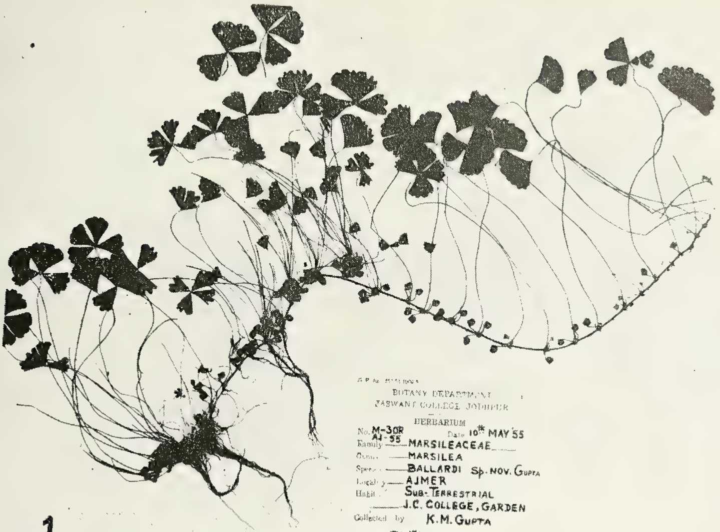
* Mehra, P. N. (1938) : Abnormal sporocarps in *M. minuta* L.—*Proc. Ind. Acad. Sci.,* Vol. VIII, No. 1 and the MS. of his full paper yet to be published.



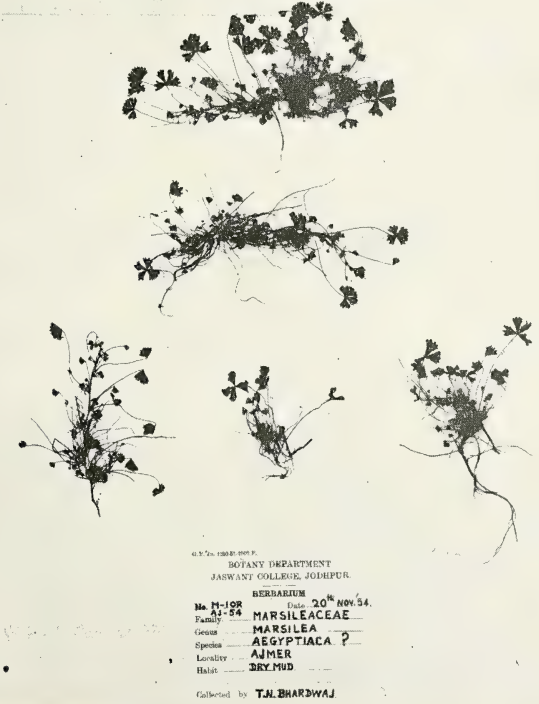
G.P. Ju. [illegible]

BOTANY DEPARTMENT
JASWANT COLLEGE JODHPUR

HERBARIUM

No. M-3OR / AJ-55 Date 10th MAY 55
Family — MARSILEACEAE
Genus — MARSILEA
Species — BALLARDI Sp. NOV. GUPTA
Locality — AJMER
Habit — SUB-TERRESTRIAL
— J.C. COLLEGE, GARDEN
Collected by K.M. GUPTA

1.



G.P. Ju. [illegible]

BOTANY DEPARTMENT
JASWANT COLLEGE, JODHPUR.

HERBARIUM

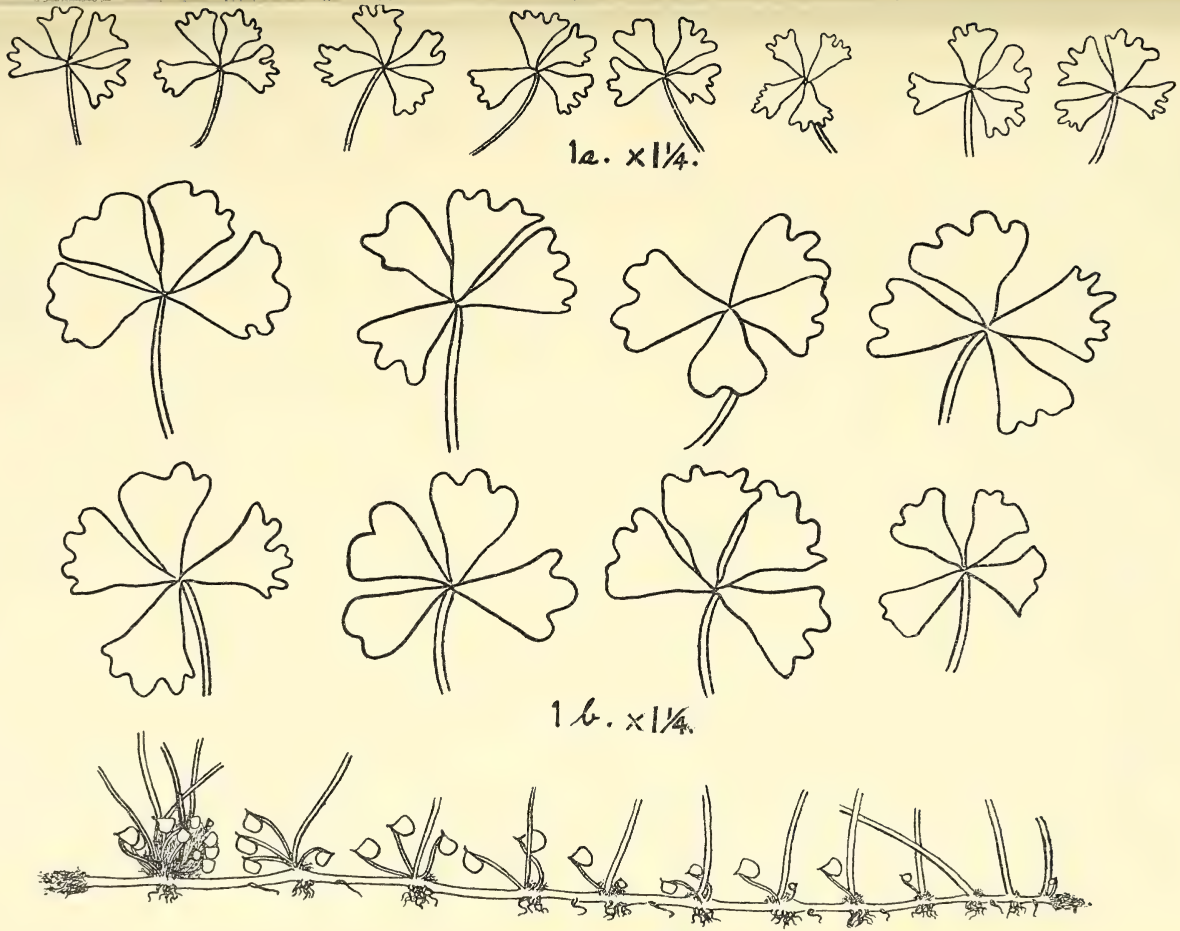
No. M-1OR / AJ-54 Date 20th NOV. 54.
Family — MARSILEACEAE
Genus — MARSILEA
Species — AEGYPTIACA ?
Locality — AJMER
Habit — DRY MUD
Collected by T.N. BHARDWAJ

2.

*Marsilea ballardii* sp. nov.

1. Photograph of the herbarium sheets No. $\frac{\text{M—3 OR}}{\text{AJ. 55}}$ preserved in the Botany Department, Jaswant College, Jodhpur, showing the general habit of the new species *M. ballardii* Gupta.

2. Same, bearing an older herbarium label when it was thought to be similar to *M. aegyptiaca* Willd.

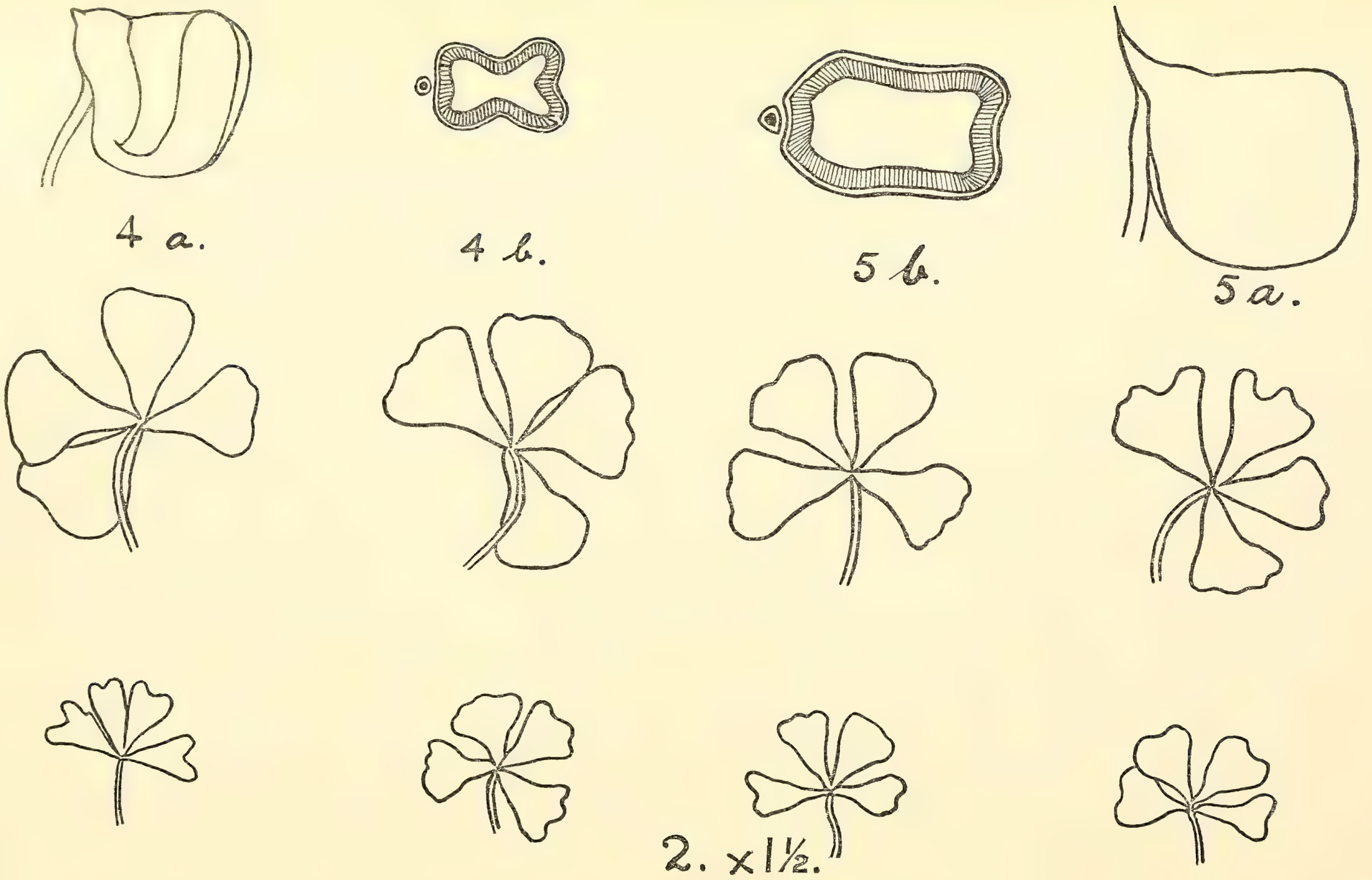


*Marsilea ballardii* sp. nov.

FIGS. 1 and 3 (diagrammatic)

Fig. 1 a & b. Variations noticed in the shape of leaflets of *M. ballardii* sp. nov.

Fig. 3. Disposition of sporocarps in *M. ballardii* sp. nov. Note the occurrence of one, two, three or more sporocarps on the same plant somewhat arranged in a sequence from the tip of the rhizome backwards.



*Marsilea ballardii* sp. nov.
FIGS. 2, 4 and 5 (diagrammatic)

Fig. 2. Variations in the shape of leaflets of *M. aegyptiaca* Willd. for comparison with *M. ballardii*.
Fig. 4 a & b. *Marsilea aegyptiaca*. Sporocarp for comparison with that of *M. ballardii*, fig. 5.
Fig. 5 a. A single sporocarp of *M. ballardii* sp. nov. to show its shape & size; the nature of its horn and attachment of the pedicel to
b. Same in section.

TABLE 1

Important distinguishing features of the four Indian species of *Marsilea*

| S. No. | Characters | *M. condensata* | *M. quadrifolia* | *M. aegyptiaca* | *M. ballardii* sp. nov. Gupta |
|---|---|---|---|---|---|
| 1. | Nature of leaflets. | Crenate. | Entire. | Entire in aquatic ; crenate in subterrestrial. | Crenate, deeply lobed. |
| 2. | Disposition of sporocarps. | In tufts. | Generally 2, sometimes 3. | Solitary. | Solitary, 2, 3 and small tufts. |
| 3. | Relation of pedicel to petiole. | Free from the base. | Adnate. | At the base. | At the base. |
| 4. | Relation of pedicel to pedicel. | Slightly connate. | Connate. | X | Free or connate. |
| 5. | Size and shape of sporocarp. | $\frac{1}{8}$", suborbicular and horizontal. | $\frac{1}{5}$"–$\frac{1}{3}$". Ovoid. | $\frac{1}{12}$"–$\frac{1}{10}$". Square with prominent grooves and depressions. | $\frac{1}{5}$" Squarish without grooves or depressions. |
| 6. | Pedicel to sporocarp ratio. | 2 : 1. | 2 : 1 or 1 : 1. | $3\frac{1}{3}$ : 1. | 2 : 1. |
| 7. | Attachment of pedicel to sporocarp. | Adnate. | Partially adnate. | Adnate. | Adnate. |
| 8. | Number and nature of the horn. | Only upper but not pointed. | Similar upper and lower. | Only upper blunt. | Only upper but pointed. |
| 9. | Soral number. | 10. | 16–20. | Generally 4, sometimes 5 or 6. | 6–8. |

ever, produces quite healthy and normal type of sporocarps and may not be a hybrid but a true species.

I have great pleasure in naming this *Marsilea* from Ajmer after Mr. F. Ballard, the expert Pteridologist at Kew. His constant help and interest in our work at Jodhpur has been very valuable.

The new species may be diagnosed as follows :—

### **Marsilea ballardii** sp. nov.

Herba aquatica vel subterrestris. Foliola crenata, marginibus alte incissis, deltoidea, sparse serica ; petioli 10–20 cms. longi in formis cultis, 4–7·5 cms. longi in formis terrestribus naturalibus. Pedicelli singuli, bini, terni vel plures simul, connati ; pedicelli adnati integrae basi conceptaculorum ; ratio pedicellum inter et sporocarpum est 2 : 1. Conceptacula horizontalia, plus minusve quadratiuscula, absque sulcis vel canalibus

*Marsileae aegyptiacae*, 5 mm. magnitud., dense pilosa, dente superiore prominente; sori 6–8.

Typus lectus a T. N. Bhardwaja mense novembri 1954, prope vicum Gugra vocatum, ad viam quae ducit ad Kishangarh, in Statu Ajmer, in India.

I am grateful to the Director, Roy. Bot. Gardens, Kew Mr. F. Ballard, the Pteridologist, Mr. A. H. G. Alston of the British Museum, London, and Prof. P. N. Mehra for their kindness, help and encouragement. My sincere thanks are due to Rev. Fr. H. Santapau for very kindly rendering the diagnosis of the new species into Latin.

BOTANY DEPARTMENT,
JASWANT COLLEGE, K. M. GUPTA
JODHPUR.
*September* 9, 1955.

## 30. UTILITY OF THE FOREST PRODUCTS OF ORISSA IN THE FISHERIES OF THE CHILKA LAKE[1]

### INTRODUCTION

Well-balanced economy in every trade requires the maximum utilization of the raw materials available in the locality. The fishery trade of the Chilka Lake is well balanced in this respect, drawing all its raw materials from the hills and jungles spreading on the western shore of the lake.

No consolidated record at present exists of the forest products made use of in preparing the varied fishing implements of the Chilka Lake. These products have helped to develop cottage industries, such as boat-making, mat and basket weaving, and leaf stitching, in addition to providing livelihood for hundreds of villagers who collect barks, plants, leaves etc.

A list of plants made use of in the fisheries trade is given below:

| Local Oriya name | | Scientific name |
|---|---|---|
| Chani or Kaunria | ... | *Crotalaria juncea* L. |
| Kanta or Pili or Dandi Bauns | ... | *Bambusa arundinacea* Willd. |
| Karada | ... | *Cleistanthus collinus* Benth. |
| Khadi siju | ... | *Euphorbia tirucalli* L. |
| Kharua noi | ... | *Ichnocarpus frutescens* R. Br. |
| Paldhua | ... | *Erythrina indica* Lamk. |
| Sahanja | ... | *Terminalia tomentosa* W. & A. |
| Sal | .. | *Shorea robusta* Gaertn. |
| Shalimba Baunsa | ... | *Dendrocalamus strictus* Nees. |
| Shiali | ... | *Bauhinia vahlii* W. & A. |
| Sunari | ... | *Cassia fistula* L. |
| Sundarkania Bauns | ... | *Bambusa vulgaris* Schrad. |
| Shuli or Bhuduka | ... | *Kydia calycina* Roxb. |

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[1] Published with the kind permission of the Deputy Director of Fisheries, Orissa.

## CRAFT AND TACKLE

The various fishing implements used for fishing in the lake may be grouped under five major heads :

1. Boats 2. Nets 3. Traps 4. Jano or enclosure 5. Rods and spears.

### Boats

Four types of boats are in operation in the lake. Devasundaram (1951) while describing them has mentioned that the dug-outs are made of *Shorea robusta*. All the other three types of boats mentioned by him are also constructed out of the same wood. The different parts of these boats are made exclusively of materials available from the local forests and the jungles surrounding the villages. To mention a few, the mast or *gula* of the boat is made of the lower portion of *Bambusa arundinacea* ; the sail or *tolei* is a mat woven out of thin and broad strips split from *B. arundinacea* or *Dendrocalamus strictus* ; bamboo mat or *chancha* or *akhdi* too is a mat consisting of thick strips made from the lower portion of *B. arundinacea* which are tied together by coir rope. The boats are partitioned into compartments by such mats also. For punting bamboo or *kado* the upper portion of *Bambusa vulgaris* or *D. strictus* is used. To the lower portion of *B. arundinacea* or *B. vulgaris* or *D. strictus* a sāl plank is fixed with nail and used as a rudder or *danda.*

Besides these, for other minor parts of the boat, bamboo is very essential.

### Nets

Devasundaram (op. cit.) has described four nets in his study of the fishing methods for mullets in the lake. Jones and Sujansinghani (1952a) have recorded another net, *Mani-jal* (better known as *muni jal* or *gania jal*), to catch the beloniform fishes. Devasundaram (1954) has given the detailed description of three more nets while dealing with the fisheries of the lake.

All the above nets can be divided into two groups with reference to the material out of which they are prepared : those made of yarn and the rest made of *Crotalaria juncea.* Cast net (*Khepa jal*), drag net (*Gania jal*, *Khoinga* or *Kabala jal*, *Menjia jal* and *Khadi jal*), seine net (*Patua jal*) and gill net (*Bhida jal*) are prepared of yarn. The last mentioned net may also be prepared of hemp, but hemp is mainly used in preparing *Bhekta jal* and *Noli jal* which are also gill nets. The wood of *Erythrina indica* and *Kydia calycina* is utilised as floats for nets like *Bhida jal*, *Bhekta jal*, *Patua jal* and *Noli jal.*

Young shoots of *B. arundinacea* with 1″ diameter or below are employed as spreader sticks for *Khadi jal*, *Khoinga jal* and *Menjia jal.*

The decoctions of the barks of *Cleistanthus collinus* and *Terminalia tomentosa* are employed to dye the nets. One pound of bark is boiled for nearly two hours in approximately three gallons of brackish water with bits of *Euphorbia tirucalli.* As the extract of *C. collinus* bark soon wears away the yarn nets, the decoction of the bark of *T. tomentosa* is used to dye them ; but for the hemp nets no restriction is observed.

Dyeing the nets with *Cassia fistula* bark extract is not practised in the Chilka area. And contrary to other parts of Orissa where nets are tanned at intervals of 2 to 3 months (I. P. F. C., 1954) here the dyeing of nets is done once a fortnight.

### Traps

Two main types of traps are used in the lake exclusively for catching prawns and crabs. Jones and Sujansinghani (1952b) have given the description of the box-trap, locally known as *konkara kharia* used for catching crabs. A slight modification of the box-trap is the *Boja* with which prawns are caught. The *Tiar* community of the fishermen make these two kinds of traps, but the other main type, known as *Dhoudi*, described by Devasundaram (op. cit.) is prepared by the *Kondara* community. The hard basal part of a full-grown bamboo (local name: *Muli*) is split into strips which are fastened together by a wild climber, *Ichnocarpus frutescens.* Normally this climber is about half an inch in circumference, rusty brown in color and possesses strong fibres. It is soaked in water before use and the epidermal layer is sometimes scraped off as required.

The leader line of these traps is generally made out of the same portion of bamboo described above, but it is split into thicker slats than those used in the traps.

### Jano or Enclosure

Bamboo mats used in the *Jano* are of the same type and material as the leader line of the traps.

### Rods and Spears

In rod angling *D. strictus* is used as a rod and for the handle of *Tenta* or spear strong *B. arundinacea* is employed.

### Other Articles

Fish is despatched to different places in rectangular baskets, the photo of which appears in the paper, 'Hilsa Fishery of the Chilka Lake' (Jones and Sujansinghani, 1951). These baskets are prepared out of *B. vulgaris* as that species of bamboo is durable and is quite easy to split into splints. Before packing the fish, a layer of sewn leaves of *Bauhinia vahlii* is spread inside the basket.

## ACKNOWLEDGEMENTS

I am grateful to Sri M. Peter Devasundaram of the Central Marine Fisheries Research Station, Mandapam, for his kind help in preparing this note.

CHILKA BIOLOGICAL STATION,
BALUGAON,
ORISSA.
*April* 30, 1955.

J. C. ROY.

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## GLEANINGS

*F. R. Fosberg in Northern Marshall Islands Expedition* 1951–52 (*Atoll Research Bulletin No.* 38 (1955)) *page* 33 :

'The *Pisonia* forest, which covers the greater part of this islet, is dense and contains some great trees, though it is uneven and shows the usual effects of typhoons in the form of fallen trees. Ordinarily these take root wherever they touch the ground, but a number seen here on Bikar were dead. Probably they were blown down during the severe dry spell. The *Pisonia* forest contained two remarkable things—white-tailed tropic birds nesting in holes in the tree trunks, and water collected in cavities and irregularities in the large tree bases containing swarms of ostracods. Where these fresh-water animals came from on an island that has absolutely no other fresh-water is indeed a mystery.'

*Adapted excerpt from the I. U.P.N. Bulletin for June* 1955.

*Deforestation.* Lesson for India. 'Ten years ago, when it rained heavily in the Esterel and Alpilles of Provence in the south of France, the water took three to four days to reach the Mediterranean coast. Today, due to the increased deforestation on the slopes, and to fires—one hundred million pines have been lost in this period—the inhabitants of Saint Raphael watch torrents of muddy water rush past them only three hours after the rainfall.'

*Charles McCann, F.L.S. in ' The Lizards of New Zealand—Gekkonidae and Scincidae '.*

'Waite (1929) in his "Reptiles and Amphibians of South Australia," narrates the exploits of two members of the South Australian Museum when trying to collect geckos on the tinned roof of a hut which was out of reach. One of the party suggested the firing of a blank from a gun inside the hut in the hope that the shock would dislodge the geckos. The suggestion was carried out with the result that there was a ' shower of geckos ' from the roof. On collecting the spoils, the collectors found that the shower consisted of geckos' tails alone ! '

*From 'A Book of Spiders'. By W. S. Bristowe. King Penguin Books,* 1947.

' A census in a Sussex field of rough grass showed a maximum spider population in late sumer slightly in excess of 2¼ millions to the acre . . . The spider population of England and Wales can, of course, only be guessed at. My guess is an average of 2⅕ billions. At a very conservative estimate each spider destroys insects at the rate of a hundred per annum, so we arrive at a yearly insect consumption in England and Wales of 220,000,000,000,000 (two hundred and twenty billions). Let me also say quite definitely that spiders eat many times the number of insects consumed by birds, whose destruction rate has probably now been exceeded also by those modern enemies, the motorists, who squash insects in millions on their windscreens and radiators. Birds get a good reputation, partly because people like them. Spiders have a bad reputation because people either actively dislike them or fail to realise the huge part they play in insect destruction.'

*From* ' *World Wool Digest* ' 22 *December* 1954.
' *Rabbits still a Problem in Australia* '

' It is generally believed that, in the normal course of events, whatever expansion takes place in Australian wool production in the near future, it will not be of the magnitude of the increase in 1952/53, when total output rose from 1,080 to 1,281 million lb. in a year. This was a ' once for all ' increase due primarily to the first successful application of myxomatosis in the destruction of millions of rabbits. The myxomatosis campaign has been kept up in subsequent seasons and much valuable information has been collected as to the effects and incidence of the disease. It has recently been suggested, however, that rabits are no longer a serious problem in Australia and that farmers can now safely discontinue such expensive precautions as netting properties and digging out and ripping warrens.

' This point of view has been severely criticised by officers of the Commonwealth Scientific and Industrial Research Organisation, which has been responsible for directing intensive experiments and research in myxomatosis. The *Pastoral Review*, of 16th October, publishes a letter on this subject by Mr. F. N. Ratcliffe, Officer-in-Charge of C.S.I.R.O.'s Wildlife Survey Section. After studying all scientific and field evidence available, Mr. Ratcliffe is of the opinion that myxomatosis will not provide the final solution to the rabbit problem. He quotes Dr. J. M. Rendel, Officer-in-Charge of the Animal Genetics Section, as giving an ' emphatic warning ' that ' the development of a rabbit population with some degree of intrinsic resistance to myxomatosis is inevitable '. The building up of this resistance, although slow at first, will increase in tempo and may become significantly apparent within ten years, in areas where annual outbreaks of myxomatosis have occurred.

' Two additional factors that may possibly contribute to the reduced efficacy of myxomatosis must also be taken into account—they are: inadequacy of insect vectors and a decrease in the virulence of the virus. In these circumstances the official policy is quite clearly to encourage the intensification of control by standard methods and to consolidate gains already made by ' mopping up ' surviving rabbit infestations. This policy is the outcome of the most careful consideration of all the facts and probabilities and has the support of the representatives of all the States and is endorsed by the virologists and geneticists who attended the recent myxomatosis conference in Melbourne.'

*Trees.*

Allan C. Garrard writes in the journal of ' The Men of the Trees ' (Vol. xviii, No. 2, Autumn 1954) :—

' . . . . Timber still forms the major portion of the wealth of Jugo-Slavia ; . . . . All the children attending primary and secondary schools are encouraged to plant trees—and the large majority do so regularly.'

*Hedges.*

In the same journal at p. 129 J. Gunston writes:—

'. . . . Farming from the artificial manure bag is undoubtedly reducing the stability of many soils ; the obvious answer to this danger is that instead of reducing the hedges and enlarging the fields, the reverse process will have to be resorted to in the very near future.'

This is written in regard to conditions in England, but can be applied to India in many parts of which the establishment of hedges of suitable design is an urgent need. Many of the existing practically useless ' hedges ' merely sketchily demarcate boundaries of cultivated plots and are just a remnant of what they should be for the purpose of protecting crops from inroads by cattle and the force of the wind which constantly removes the valuable top-soil from the ploughed land. Hedges of the many suitable plants, such as *Erythrina suberosa* and others with leguminous properties, do not cast heavy shade on the growing crops and obviate the heavy and recurrent labour of making thorny barriers against roaming cattle. Such hedges are permanent wind-breaks and erosion barriers, attract birds useful to the cultivator, and generally useful in other ways also. (R. W. Burton).

*Extract from All-India Khadi and Village Industries Board, Bombay, Circular letter No. PG—II—*24/54 *dated* 11-10-54 :

## GŪR (JAGGERY) FROM PALMYRA PALMS

' Palms as a source of sugar supply are gaining wide importance in all the palm-growing countries of the world. World population is increasing by 68,000 per day, and in India the annual increase in the population is about 38 lakhs. In view of this alarming increase in the population, a time may come when we shall have to release most of the land where sugar-cane is growing today and use it for growing foodcrops. The demand for sugar will have to be met from cheaper sources such as palms, which can grow in a waste strip of land. With the existing number of 5 crores of tap-able palms, it is estimated that we may be able to make 1 to 1½ million tons of Palm Gūr per annum. At present 20 to 23 lakh acres of fertile land are under sugarcane cultivation meant for cane gūr manufacture. The estimated production of Palm Gur will release 10 lakh acres of fertile land for other foodcrops. In all, the industry can give seasonal employment to 25 lakh rural workers and thus can relieve unemployment to a considerable extent.'

# NOTES AND NEWS

The Society is now in a position to offer some amounts for the carrying out of field work in natural history, which includes the collection of specimens or data, or the investigation of specific problems.

Applications should be addressed to: The Honorary Secretary, Bombay Natural History Society, 114, Apollo Street, Bombay, stating (1) the nature of the problem; (2) the experience and qualifications of the candidate and (3) the amount required, with itemized details of how it is proposed to be spent.

Applications should be received before 31st January, 1956.

Applicants may be asked to interview the Committee in Bombay, if considered necessary.

* * * *

As we go to press, news has come of the death (on 8 December) following an attack of coronary thrombosis, of Dr. S. L. Hora, Director of the Zoological Survey of India and a valued member of the Society's Advisory Committee. A fuller obituary will follow.

# ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING 31st DECEMBER 1954

## *President*

DR. HAREKRUSHNA MAHTAB, *Governor of Bombay*

## *Vice-Presidents*

MAJOR-GENERAL SIR SAHIB SINGH SOKHEY, I.M.S. (Retd.)
REV. FR. H. SANTAPAU, S.J.
MR. SÁLIM ALI

## *Executive Committee*

| | |
|---|---|
| Prof. S. P. Agharkar, M.A., Ph.D., F.L.S., F.N.I. | *Poona* |
| Mr. J. I. Alfrey, F.R.E.S. | *Bombay* |
| Mr. G. V. Bedekar, I.C.S. | |
| Mr. R. E. Hawkins | |
| Dr. C. V. Kulkarni, M.Sc., Ph.D. | |
| Mr. D. N. Marshall | |
| Mr. D. J. Panday | |
| Mr. D. E. Reuben, I.C.S. (Retd.) | |
| Mr. J. A. Singh, I.F.S. | *Poona* |
| Mr. Humayun Abdulali (Hon. Secretary) | *Bombay* |
| Mr. M. J. Dickins (Hon. Treasurer) | |

## *Advisory Committee*

| | |
|---|---|
| Mr. H. G. Acharya, B.A., F.R.E.S. | *Ahmedabad* |
| Sir Chintaman Deshmukh, Kt., C.I.E., I.C.S. | *New Delhi* |
| Rev. Fr. Dr. J. B. Freeman, M.A., L.T., Ph.D., D.D. | *Mysore* |
| Mr. E. P. Gee, M.A., C.M.Z.S. | *Assam* |
| Dr. S. L. Hora, D.Sc. | *Calcutta* |
| Col. R. C. Morris, F.R.G.S., F.Z.S. | *Attikan* |
| Lt.-Col. E. G. Phythian-Adams, O.B.E., F.Z.S., I.A. (Retd.) | *Nilgiris* |
| Dr. Baini Prasad, D.Sc. | *New Delhi* |
| Dr. M. L. Roonwal, M.Sc., Ph.D., F.N.I., F.Z.S.I. | *Dehra Dun* |

List of members of the Executive and Advisory Committees elected for the year 1955 :

## *Vice-Presidents*

Major-General Sir Sahib Singh Sokhey, I.M.S.
Rev. Fr. H. Santapau, S.J.
Mr. Sálim Ali

### *Executive Committee*

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| Prof. F. R. Bharucha, D.SC., F.N.I. | |
| Mr. R. E. Hawkins | |
| Dr. C. V. Kulkarni, M.SC., Ph.D. | |
| Mr. D. N. Marshall | |
| Mr. D. J. Panday | |
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| Sir Chintaman Deshmukh, Kt., C.I.E., I.C.S. | *New Delhi* |
| Rev. Fr. Dr. J. B. Freeman, M.A., L.T., Ph.D., D.D. | *Mysore* |
| Mr. E. P. Gee, M.A., C.M.Z.S. | *Assam* |
| Dr. S. L. Hora, D.SC. | *Calcutta* |
| Col. R. C. Morris, F.R.G.S., F.Z.S. | *Attikan* |
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| Dr. Baini Prasad, D.SC. | *Dehra Dun* |
| Dr. M. L. Roonwal, M.SC., Ph.D., F.N.I., F.Z.S.I. | *Dehra Dun* |

## HONORARY SECRETARY'S REPORT FOR THE YEAR 1954

### THE SOCIETY'S JOURNAL

Parts 1, 2 and 3 of Volume 52 (the last two numbers being combined due to unavoidable printing delays) and the Index to Parts 1 and 2 of Volume 51 were published during the year.

### MAMMALS

Two papers by M. R. N. Prasad on the Natural History and Food of the Indian Gerbille—*Tatera indica cuvieri* (Waterhouse) were published. Mr. Prasad was able to conduct these activities with the aid of a financial grant from the Education Ministry, Government of India. The information regarding the habits, habitat, food and reproduction, with some observations on the animal's importance to agriculture, serves to draw attention to the great paucity of data concerning even some of the commonest species of animals in India.

'A Note on the position of Rhinoceros in the Union of Burma (1953)' together with a supplementary note on the same subject by U Tun Yin is an attempt to bring up-to-date the information presented by W. F. H. Ansell in 1947 (*JBNHS*, 47 : 258, *et seq*.). From the scattered evidence which has been brought together, it appears that a few individuals of both *Rhinoceros sondaicus* and *Dicerorhinus sumatrensis* still exist in Burma. He believes that the Thamin is on the increase in the Union of Burma thanks to the scarcity of shot-gun ammunition during the war years when these deer, together with other game, increased to some extent.

## BIRDS

Sálim Ali who carried out the ornithological survey of Gujarat some years ago has now reported (Vol. 52) on the extensive collections made in the area which covered Kutch, parts of Saurashtra and the north-western part of Bombay State down to the Surat Dangs, a little north of Nasik. The northern part of this area, particularly Kutch, is of great interest from the point of view of bird migration and the author has drawn attention to the possibilities it offers for the study of migration to and from India by the establishment of a chain of observation posts manned by competent observers. A large amount of the guess work which necessarily attaches to our records of bird migration in India could be eliminated by actual observations in this way.

M. D. Lister gives an account of the different species noted in the Darjeeling area during periods of leave from war service in the years 1943–45. It includes a commendable attempt at recording the calls of various birds.

Some interesting records of the stomach contents of the Greater and Lesser Flamingo at the 'Soda' lakes in Kenya are provided by M. W. Ridley in his 'Observations on Diet of Flamingoes'. While the larger species was found to take insect larvae, a few Copepods and seeds, the diet of the Lesser Flamingo seems almost entirely restricted to blue-green Algae.

In 'Petrels, Shearwaters and other Oceanic Birds in the North Indian Ocean', W. W. A. Phillips supplements information recorded in an earlier paper on the birds of the Indian Ocean [*JBNHS*, 49 (3)]. The present contribution contains extracts from his diary of two voyages from Colombo to Aden and back. They indicate the scarcity and abundance of both Petrels and Shearwaters at different seasons, and throw some light on the migrations of these birds.

In the third and concluding part of 'Some Breeding Birds of Singapore', W. T. Loke maintains his usual high standard of bird photography and furnishes many useful notes under each species.

S. Dillon Ripley offers 'Comments on the Biogeography of Arabia with particular reference to Birds'. The several relict forms of partridge and woodpecker among birds and the Arabian tahr among mammals are considered in discussing the climatic history of Arabia. The mountain ranges of Southern Arabia still hold out much promise to the diligent field worker.

C. Vaurie and K. S. Dharmakumarsinhji describe a new race of Sandlark from Saurashtra. This, *Calandrella raytal krishnakumarsinhji*, is distinguished from other Indian forms by being more heavily streaked and much darker in all its plumages.

## REPTILES AND AMPHIBIANS

No paper on either Reptiles or Amphibians was received during the year, but our Miscellaneous Notes show a continued interest in these subjects, and it is to be hoped that the interest will grow and become more general. Since the days of Col. Wall the study of snakes unfortunately appears to have fallen completely in the background.

## FISH AND FISHERIES

Charles McCann discusses the paper by E. W. Gudger published earlier in the *Journal* and asserts, from his observations, that the Whale Shark is essentially herbivorous, feeding almost entirely on marine algae. The Basking Shark, *Cetorhinus maximus*, on the other hand, states McCann, is a zoo-plankton feeder having its mouth parts adapted for this type of food.

P. I. Chacko and B. Krishnamurthi published the results of their study of the Cichlid fish—*Tilapia mossambica* Peters, a native of Africa which was introduced into Madras in 1952 on account of the ease with which it is cultivated as a source of food. They give notes on its food and feeding, growth, association with other fish, breeding, development, etc.

E. R. A. de Zylva in his 'The Development of Ceylon's Fishing Industry' indicates that the industry in Ceylon is at a low level of efficiency chiefly due to the use of primitive craft, the absence of capital for investment, the social prejudices against the trade and the lack of incentive in general. De Zylva recommends inclusion of a course of fishery studies in the University of Ceylon as a means of improving the island's fishing industry.

## INVERTEBRATES

Invertebrates appear to have found an increasing number of adherents and during the year ten papers were published in this section. M. L. Roonwal contributed three, two of which dealt with the 'Biology and Ecology of Oriental Termites', the first referring to the species *Odontotermes parvidens* which was found to damage the bark of standing teak trees in Uttar Pradesh. The second paper dealt with the natural ecological adjustment between the two species, *Coptotermes heimi* and *Odontotermes redemanni*. His third article on the Common Indian Tree Ant, *Crematogaster dohrni rogenhoferi* Mayr, describes in detail with illustrations, the structure and composition of the nest and its population.

The habits of *Myrmarachne plataleoides* Cambr. and *Amyciaea forticeps* (Cambr.)—two well-known spiders which mimic the Indian Red Ant, *Oecophylla smaragdina* (Fabr.)—were studied in detail by A. P. Mathew and the results were recorded in his 'Observations on the Habits of two Spider Mimics of the Red Ant, *Oecophylla smaragdina* (Fabr.)'. The two spiders belong to two unrelated families and it is interesting to see how each, with its particular characteristics, has effected this simulation of the same model.

A second paper on the Arachnids entitled 'Ecology and Behaviour of the Scorpion—*Palamnaeus bengalensis* C. Koch' was contributed by M. S. Kanungo.

Following up several Miscellaneous Notes on Land Leeches, Mr. J. L. Harrison of Kuala Lumpur submitted a comprehensive article regarding the species, distribution, food habits and other aspects of Land

Leeches. The question 'What are the normal hosts of Land Leeches?' however, still remains unanswered.

P. J. Sanjeeva Raj in 'A Synopsis of the Genus *Ozobranchus* (de Quatrefages 1852)—Hirudinea, Annelida' examines the nomenclature and validity of the six species which have been recorded from different hosts, all as ectoparasites on marine turtles and freshwater tortoises.

A. E. G. Best collected butterflies between April 1950 and February 1952 from the Nagalapuram Hills near Madras City, which form the outer spur of the Eastern Ghats. He lists the species with information regarding frequency and seasons of occurrence in his 'Notes on the Butterflies of the Nagalapuram Hills, Eastern Ghats'.

'Growth-Rate of the Pearl Oyster, *Pinctada pinctada*, in the Gulf of Cutch with a note on the Pearl Fishery of 1953' by S. V. Gokhale, C. R. Eswaran and R. Narasimhan is of both scientific and commercial value and embodies the results of investigations of the growth-rate of the Pearl Oyster under the Pearl Oyster Research Scheme sanctioned by the Government of Saurashtra.

## BOTANY

Many papers on botanical subjects were offered and twelve have been published during the year. S. L. Nayar completed his annotated list of 'Poisonous seeds of India' in two parts. One hundred and six species are alphabetically arranged and, in addition to the Indian and English names, information regarding the distribution of the plant and the constitution of the seed together with remarks on the nature of the poisoning are listed.

Among regional floras are papers on 'Backwater Flora of the West Coast of South India' by Rajasekhara Mudaliar and Sunanda Kamath, 'A Contribution to the Flora of Mussoorie' by N. A. Watts and 'The Vegetation of Pilani and its Neighbourhood' by T. S. Bakshi.

Of taxonomical interest are the following:

1. 'Critical Notes on the identity and nomenclature of some Bombay Plants' by R. Fernandes and H. Santapau.

This is a continuation of a series of papers by the senior author dealing with a considerable collection of plants made in the Krishnagiri National Park, Borivli, Salsette.

2. 'The Genus *Cyathula* Lour. in India' by T. S. Bakshi.

The author concludes that the density or sparseness of hairy outgrowth, on which the identity of the two species *Cyathula tomentosa* and *Cyathula capitata* has been based, depends upon the altitude at which the plants grow. Thus the two names are merely synonyms.

3. 'A New Species of *Arthraxon* from Purandhar, Bombay State' by F. R. Bharucha and Y. Satyanarayan.

4. 'New Species of Indian Plants' by R. Seshagiri Rao.

R. Seshagiri Rao described two species of *Paragrewia poilanei* and *Chonemorpha pedicellata* in the earlier numbers of the journals of the Bombay Natural History Society and Indian Botanical Society, but omitted the Latin descriptions. These are now appended.

5. With 'The Genus *Cymbopogon* Spreng. in India, Burma and Ceylon' N. L. Bor completes his exhaustive paper which includes descriptions of several new species of Indian grasses.

6. In 'On the Occurrence of *Ephedra* in the Indian Desert' M. M. Bhandari identifies as this species some plants which have been wrongly attributed to *Calligonum polygonoides* in earlier literature.

7. In 'Periodicity of the Plankton Diatoms of the Chilka Lake for the years 1950 and 1951', J. C. Roy records the results of collections made in three different zones on the Chilka Lake and tabulates the periodicities of the species collected. The article is a useful contribution to the sparse literature on the diatoms of brackish and estuarine waters of India.

### FORESTRY

'Report on the Forests of the Northern Triangle, Kachin State, Northern Burma' by F. Kingdon-Ward is a continuation of the author's observations recorded in the *Journal* earlier—'A Sketch of the Botany and Geography of North Burma'. It is a report on his 8½ months expedition along the upper reaches of the Irrawaddy River and discusses the climatic conditions and economics of the vegetation in that area.

### WILD LIFE PRESERVATION

With a view to give to members an idea of well-organized national parks in other countries we published a note on the Kruger National Park by A. St. J. Macdonald. This account illustrated with some excellent photographs kindly supplied by the South African Railways indicates how tame and fearless some of the animals have become. It is hoped that it will be possible to attain similar conditions in the several national parks that are now being set up and planned in different parts of India.

We also published the 'Annual Report for 1953 on the Eastern Region' by Mr. E. P. Gee, Regional Secretary of the Indian Board for Wild Life. This zone comprises Assam, Bengal, Bihar, Manipur, Orissa and Tripura. Mr. Gee offers remarks on the several species of animals, birds and reptiles which require special protection and gives a short summary of the activities and legislation in the various units relating to the State Wild Life Sanctuaries and National Parks. He stresses the need for educating children in the value of preserving wild life by means of suitable text books and in other ways.

U Tun Yin in 'Wild Life Preservation and Sanctuaries in the Union of Burma' describes eleven wild life sanctuaries existing in different parts of Burma and covering 914.87 square miles. A short history of each sanctuary together with its principal animals is included.

K. M. Kirkpatrick describes with excellent line drawings some of the methods used by aboriginals in different parts of India prior to the introduction of fire arms. Many of these are still employed by aboriginals in parts of Bihar and Orissa for killing even large animals like tiger and panther.

### MISCELLANEOUS NOTES

Ninety-two notes covering all branches of natural history were published. This section is always popular with readers, and more contributions would be welcome.

### SCIENTIFIC EXPEDITIONS

The Society was unfortunately not in a position to undertake any major scientific expedition during the year, but has now at its disposal some small amounts of money which could be made available to members and others to assist them in carrying out minor field trips for some specific collecting or investigation.

### NATURE EDUCATION

The Society's nature education scheme has now been running for 8 years with the aid of yearly financial grants from the Government of Bombay. Unfortunately we have not yet succeeded in persuading Government to make it a permanent feature of the State's educational programme. Under the present uncertain year-to-year arrangement it is not possible to undertake any long-term schemes or planning, and thus the full usefulness of the work is somewhat vitiated. An illustrated booklet entitled 'Our Birds' was published simultaneously in English, Hindi, Marathi and Gujarathi and has had a very favourable reception. The English edition is sold out; Marathi and Gujarati have a fair demand, but curiously enough the Hindi edition has provoked very little interest, in spite of the fact that it was commended by the Union Education Ministry to the educational departments of such Hindi speaking States as Madhya Pradesh and Uttar Pradesh. Two more books in the same series are now under preparation.

### PUBLICATIONS

The following books were published during the year :—

1. Some Beautiful Indian Trees by Rev. E. Blatter, S.J., and W. S. Millard. 2nd edition. Revised and brought up-to-date. With 31 coloured and 37 monochrome plates, and numerous text-figures.
2. Some Beautiful Indian Climbers and Shrubs by N. L. Bor and M. B. Raizada. With 31 coloured and 99 half-tone plates, and numerous text-figures.

### REVENUE ACCOUNT

The total receipts during the year amounted to Rs. 37,593-6-8, which includes a grant of Rs. 4,000 from the Government of Bombay, as compared with Rs. 46,317-1-8, during the previous year. It will be noted that this decrease in the total revenue is due to the Society not receiving the Government of India's usual grant-in-aid for 1954–55.

Sales of the Society's publications remained practically on much the same level as last year. Although calendars were in good demand, there was an appreciable reduction in the sales of the *Journal.*

The following is a comparative statement showing the different sources of revenue received in 1953 and 1954 :—

| | Revenue in 1953 | | | Revenue in 1954 | | | Increase in 1954 | | | Decrease in 1954 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rs. | a. | p. | Rs. | a. | p. | Rs. | a. | p. | Rs. | a. | p. |
| Subscriptions ... | 20,635 | 0 | 0 | 20,418 | 0 | 0 | —— | | | 217 | 0 | 0 |
| Entrance Fees ... | 1,135 | 0 | 0 | 1,412 | 0 | 0 | 277 | 0 | 0 | —— | | |
| *Publications* : | | | | | | | | | | | | |
| Books ... | 4,801 | 0 | 0 | 5,691 | 0 | 0 | 890 | 0 | 0 | —— | | |
| Journals ... | 3,374 | 0 | 0 | 1,634 | 0 | 0 | —— | | | 1,740 | 0 | 0 |
| Sundries, Taxidermy, Advertisement, etc. | 388 | 0 | 0 | 346 | 0 | 0 | —— | | | 42 | 0 | 0 |
| Interest on Investments | 3,984 | 0 | 0 | 4,092 | 0 | 0 | 108 | 0 | 0 | —— | | |
| *Grants* : | | | | | | | | | | | | |
| Govt. of India ... | 8,000 | 0 | 0 | —— | | | —— | | | 8,000 | 0 | 0 |
| Govt. of Bombay ... | 4,000 | 0 | 0 | 4,000 | 0 | 0 | —— | | | —— | | |
| Total ... | 46,317 | 0 | 0 | 37,593 | 0 | 0 | 1,275 | 0 | 0 | 9,999 | 0 | 0 |

The net decrease in 1954 as compared with 1953 was Rs. 8,724.

The total number of members on our books as at 31st December 1954 was 1,110 of whom 227 were life members. Subscription for 1954 have so far been received from 668 members. During the year 54 new members joined ; 4 life members and 10 ordinary members died ; 5 ordinary members became life members and 21 ordinary members resigned.

## STAFF

The Committee wishes to record its appreciation of the willing co-operation of the entire staff in the activities of the Society.

## ACKNOWLEDGEMENTS

The Committee's thanks are due to Mr. P. M. D. Sanderson who continues to look after the Society's interests in the U.K.

## APPENDIX TO THE HONORARY SECRETARY'S REPORT COVERING THE PERIOD JANUARY TO AUGUST 1955

This is a supplementary report embodying the activities of the Society from January to August this year.

*Natural History Award*: No fresh application for the year 1955–56 was entertained, but the one granted to Mr. K. K. Dixit of Poona for work on colour perception and sensory physiology of Indian Honey Bees has been extended to December 1955.

During 1955, up-to-date, forty new members (including one life member) joined, against which 4 died and 17 resigned and one ordinary member became life member, bringing the number of ordinary members on our rolls to 900. In addition we have 299 life members. Only 600 ordinary members have so far paid their subscriptions for 1955.

The fifth edition of Sálim Ali's 'The Book of Indian Birds' has at last been published and it is hoped that it will be possible to have Wynter-Blyth's 'Butterflies of the Indian Region' ready before Christmas. The Society's Nature Calendar for 1956 is under preparation and should be available by the middle of October, well in time for despatch to foreign countries.

Active preparations are under way for bringing out a revised second edition of S. H. Prater's 'The Book of Indian Animals' in which it is intended to replace several of the unsatisfactory coloured plates by better ones.

The Wall Chart on how to identify poisonous snakes has also been out of print for some years. This publication has proved its usefulness and is in great demand by Government hospitals and dispensaries all over the country. Steps are being taken to publish the new edition in English, Gujarati and Marathi.

In the matter of wild life preservation, the Government of Bombay have appointed R. S. Dharmakumarsinhji, an active member of our Society, as the first full-time Officer. Several members of the Society are also acting as Honorary Game Wardens and it is hoped that this effort, with which the Society was initially actively associated, will be successful. The most serious menace to game and wild life is the great increase in the number of Arms Licences issued for the alleged purpose of crop protection.

It was not possible to arrange for lectures or scientific film shows during this period. On 19th July, however, Prof. J. Berlioz of the Natural History Museum, Paris, now on a visit to India, gave an interesting talk to members and their friends on Humming Birds and Sunbirds. Prof. Berlioz is a world authority on the Humming Bird group.

Mr. Loke Wan Tho, a vice-patron of the Society, and one of its constant benefactors, financed a continuation of the Sikkim Ornithological Survey to enable further field work to be carried out and data relating to a different season of the year to be obtained.

Mr. Loke has also donated to the Society the cost of reproducing two coloured plates from his own Kodachrome transparencies of birds, thereby adding considerably to the attractiveness of the *Journal.*

The following 62 members have joined since the last Annual General Meeting:

*From 23rd August to 31st December* 1954

Lt. Col. A. S. Bedi, c/o. New Delhi 56 A.P.O.; Mr. P. P. Sehgal, New Delhi; The Divisional Forest Officer, North Kheri Division, U.P.; The Principal, Jaswant College, Jodhpur; Sirdar Bhupendra Kumar, Dholpur, Rajasthan; Mr. P. B. Biswas, Tribeni Tissues, Ltd., Hooghly; His Highness the Maharaja Fatesingrao Gaekwad of Baroda, Baroda; Mr. Roderick W. Mackay, Kurseong P.O.; The Divisional Forest Officer, East Thana, Nasik; Mr. G. A. Stewart, Bombay 1; Mr. P. S. Daver, Bombay 1; Mr. W. Wally, Calcutta; The Principal, College of Science, Raipur; Mr. Bernard C. Bowker, Miami, U.S.A; Dr. Telford H. Work, Virus Research Centre, Poona; Mr. G. R. Iredale, Calcutta; The Librarian, Birla Central Library, Pilani; Mr. G. W. Fairhurst, Calcutta; Mr. Dwight Platt, Sambalpur; Mr. J. N. Onial, Dehra Dun; Mr. Everett W. Neely, Los Angeles, U.S.A.

*From* 1*st January* 1955 *to* 16*th August* 1955

Mr. W. R. Duffin, Calcutta; Mr. Aamir Ali, Geneva, Switzerland; The Commandant, National Defence Academy Wild Life Club, Khadakvasla; Mr. Robert King, Kingston, Massachusetts, U.S.A.; The Principal, C.M.S. College, Kottayam; Shri Dinkar Desai, Bombay 4; The Principal, Brooks Agri. I.E.M. School, Bilaspur; Mr. Charles Cyril Roy Goodwin, Bombay; The Conservator General of Forests, Calcutta; Mr. Akbar Hatim Badruddin Tyabji, c/o. Pakistan High Commission, Calcutta; The Registrar, Shri Venketeswara University, Tirupati; The Secretary, Wild Life Club, Indian Forest College, Dehra Dun; Mr. K. K. Neelakantan, Palghat; The Hydrologist, Fisheries, Bhavanisagar; Mr. Eric Ernest Fennell, Kotagiri; Mr. G. Seshappa, Bombay 5; Mrs. S. Kumar, Bombay 6; The Director, National Botanical Garden, Lucknow; Mrs. Usha Ganguli, Delhi 8; The Librarian, Niedersachsische Staat und Universitätsbibliothek, Gottingen, Germany; The Principal, Scottish Church College, Calcutta 6; The University Librarian, M.S. University of Baroda, Baroda 2; The Principal, Kamala Raja Girls' College, Gwalior; The Principal, Mahakoshal Maha Vidyalaya, Jabalpur; His Highness the Raja Bahadur Shivaram Sawant Bhonsle, Belgaum; Mr. Saul Blickman, U.S.A.; The Head, Department of Biology, St. Joseph's College, Darjeeling; The Director of Agriculture, Bangalore; Shri Hare Krushna Mahatab, Governor of Bombay; Mrs. Julia Allen Field, Florida, U.S.A.; Dr. Henry Field, Coconut Grove, Florida, U.S.A.; Rev. Fr. C. Massot, Yercaud P.O.; His Excellency Philip K. Crowe, U.S. Ambassador in Ceylon; Mr. H. G. Fennell, Valparai P.O.; Raj Kumar P.S. Jung, Sahanpur; Dr. Oscar T. Owre, University of Miami, Florida, U.S.A.; Mr. J.P.K. Martin, Nazira P.O.; Mr. Jaiwant Achutrao Gaitonde, Bombay 1; Mr. James A. Harvie, Kanpur; Group Capt. E.M.T. Howell, Kirkee.

## BOMBAY NATURAL HISTORY SOCIETY

### *BALANCE SHEET AS AT 31 DECEMBER 1954*

| LIABILITIES | | Rs A P | Rs A P |
|---|---|---|---|
| *Life Membership Fees* ... ... ... | | | 92,793 10 8 |
| *Advance Subscriptions and Entrance Fees* ... | | | 570 14 3 |
| *Donations* ... ... ... ... ... | | 2,000 0 0 | |
| *ess:* Spent for expedition ... ... ... | | 100 0 0 | 1,900 0 0 |
| *Mamal Survey Fund Account* ... ... | | | 2,604 12 7 |
| *Sundry Creditors:* | | | |
| For Printing of Journals ... ... | | 9 060 5 0 | |
| ,, *Birds of Kutch* ... ... ... | | 26 11 0 | |
| ,, Natural History Award ... ... | | 200 0 0 | |
| ,, *Expenses:* | | | |
| Royalties to Authors of Books ... | | 346 13 0 | |
| Expenses: (Audit Fee and Telephone charges) ... ... ... | | 269 6 0 | |
| Others ... ... ... ... | | 382 9 0 | 10,285 12 0 |
| *Provision for part cost of:* | | | |
| 1. *Book of Indian Butterflies* | | | |
| As per last Balance Sheet | 13,000 | | |
| *Add:* Grant from Government of India ... ... ... | 5,000 | 18,000 0 0 | |
| 2. *Some Beautiful Indian Climbers and Shrubs* | | | |
| As per last Balance Sheet ... | | 3,00 0 0 | |
| 3. *Book of Indian Birds—V Edition* | | | |
| As per last Balance Sheet ... | | 4,000 0 0 | |
| 4. *Some Beautiful Indian Trees* | | | |
| As per last Balance Sheet ... | | 4,500 0 0 | 29,500 0 0 |
| *Surplus Account:* | | | |
| Balance as per last Balance Sheet ... | | 51,727 9 10 | |
| *Add:* Excess of Income over Expenditure ... | | 8 0 8 | 51,735 10 6 |
| Carried forward ... | | | 1,89,390 12 0 |

| ASSETS | | Rs A P | Rs A P |
|---|---|---|---|
| *Investments: At cost* | | | |
| Rs. 14,000 4% Bombay Port Trust Bonds | | 10,780 0 0 | |
| ,, 15,000 4% Bombay Improvement Bonds ... | | 11,400 0 0 | |
| ,, 36,000 3% Funding Loan 1966-68 ... | | 35,812 10 0 | |
| ,, 25,000 3% Conversion Loan 1946 ... | | 25,000 0 0 | |
| ,, 2,000 3% First Development Loan 1970-75 ... | | 1,948 12 0 | |
| ,, 92,000 | | 84,941 6 0 | |
| (Market value on 31 December 1954 Rs. 83,478-12-0) | | | |
| £460 3½% Defence Bonds ... ... | | 6,133 5 4 | 91,074 11 4 |
| *Furniture:* | | | |
| As per last Balance Sheet ... ... ... | | 2,666 11 0 | |
| *Less*—Depreciation... ... ... ... | | 166 11 0 | 2,500 0 0 |
| *Sundry Debtors* ... ... ... ... | | | 4,197 12 6 |
| *Government of Bombay—Grants* ... ... | | | 4,000 0 0 |
| *Nature Education Scheme:* (As per statement attached) ... ... | | | 3,382 14 3 |
| *Loans to Staff* ... ... ... ... | | | 1,605 0 0 |
| *Interest accrued on Fixed Deposit* ... ... | | | 93 12 0 |
| *Process Cost of Publications:* | | | |
| *Some Beautiful Indian Climbers and Shrubs* | | | |
| As per last Balance Sheet | 6,293 6 4 | | |
| Additions during the year | 129 2 6 | 6,422 8 10 | |
| *Book of Indian Butterflies* | | | |
| As per last Balance Sheet | 2,208 13 6 | | |
| Additions during the year | 9 3 0 | 2,218 0 6 | |
| *Book of Indian Birds* | | | |
| As per last Balance Sheet | 5,166 1 0 | | |
| Additions during the year | 10,675 6 6 | 15,841 7 6 | |
| *Some Beautiful Indian Trees* | | | |
| As per last Balance Sheet | 10,635 1 9 | | |
| Additions during the year | 1 7 0 | 10,636 8 9 | 35,118 9 7 |
| Carried forward ... | | | 1,41,972 11 8 |

## BALANCE SHEET AS AT 31st DECEMBER 1954—(*Continued*)

| LIABILITIES | Rs A P | Rs A P | ASSETS | Rs A P | Rs A P |
|---|---|---|---|---|---|
| Brought forward ... | | 1,89,390 12 0 | Brought forward ... | | 1,41,972 1 8 |
| | | | *Stock of Books, etc., on hand:* | | |
| | | | (At cost or under) as certified by the Honorary Secretary: | | |
| | | | *Book of Indian Birds*—23 copies ... | 139 0 0 | |
| | | | *Book of Indian Animals*—594 copies ... | 2,374 0 0 | |
| | | | *Circumventing the Mahseer and other Sporting Fish in India*—393 copies ... | 1,112 0 0 | |
| | | | *Game Birds of India*, Vol. III (Bound and unbound) 381 copies ... ... | 1,787 0 0 | |
| | | | *Indian Molluscs*—834 copies ... ... | 1,617 0 0 | |
| | | | *Indian Hill Birds*—3 copies ... ... | 48 12 0 | |
| | | | *Whistler's Popular Bird Book* 2 copies ... | 27 14 0 | |
| | | | *Birds of Travancore*—3 copies ... ... | 57 2 0 | |
| | | | Journals—15,400 Nos. ... ... ... | 3,850 0 0 | |
| | | | | 11,012 12 0 | |
| | | | Cardboards for packing (Bird Book) ... | 56 2 0 | 11,068 14 0 |
| | | | *Cash and other Balances:* | | |
| | | | In hand ... ... ... ... ... | 350 0 0 | |
| | | | With the National Bank of India, Ltd., Bombay—Fixed Deposit ... ... | 25,000 0 0 | |
| | | | With the National Bank of India, Ltd., Bombay (on Current Account) ... | 8,537 14 4 | |
| | | | With the National Bank of India, Ltd., London, (£184-11-11) ... ... ... | 2,461 4 0 | 36,349 2 4 |
| Total ... | | 1,89,390 12 0 | Total ... | | 1,89,390 12 0 |

We have prepared the above Balance Sheet from the Books of Account maintained and from the information given to us, and have verified the Investments, and Bank Balances. In our opinion such Balance Sheet represents a true and correct view of the state of the Society's affairs according to the best of our information and explanations given to us.

BOMBAY, *14th May, 1955.*

(Sd.) A. F. FERGUSON & CO.,
*Chartered Accountants.*

# BOMBAY NATURAL HISTORY SOCIETY

Dr. *INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1954* Cr.

| Expenditure | Rs A P | Rs A P | Income | Rs A P | Rs A P |
|---|---|---|---|---|---|
| To Salaries (including Dearness Allowance) | | 15,981 5 0 | By Subscriptions ... ... ... ... | | 20,418 0 9 |
| ,, Contribution to Staff Provident Fund ... | | 972 1 0 | ,, Entrance Fees ... ... ... ... | | 1,412 0 0 |
| ,, Cost of Printing of Journal ... ... | | 14,052 7 0 | ,, Journal—retail sales ... ... ... | | 1,634 8 0 |
| ,, Editor's Travelling Expenses ... ... | | 200 0 0 | | | |
| ,, Rent ... ... ... ... ... | | 2,220 0 0 | ,, *Publications:* | | |
| ,, General Charges ... ... ... | | ,124 10 3 | Profits on: | | |
| ,, Postage ... ... ... ... | | 932 8 3 | *Book of Indian Birds* ... ... ... | 8 6 0 | |
| ,, Stationery and Printing ... ... | | 432 13 0 | *Book of Indian Animals* ... ... | 2,098 3 8 | |
| ,, Library ... ... ... ... ... | | 602 14 6 | *Circumventing the Mahseer and other Sporting Fish* ... ... ... | 341 15 0 | |
| ,, Fire Insurance ... ... ... ... | | 150 0 0 | *Indian Molluscs* ... ... ... | 51 9 0 | |
| ,, Audit Fee ... ... ... ... | | 250 0 0 | *Game Birds of India*—Vol. III ... | 14 13 0 | |
| ,, Natural History Award ... ... ... | | 500 0 0 | Bird Picture Post Cards ... ... | 78 9 6 | |
| ,, Depreciation on Furniture ... ... | | 166 11 0 | Calendars ... ... ... ... | 2,623 10 3 | |
| ,, Excess of Income over Expenditure ... | | 8 0 8 | Taxidermy, etc. ... ... ... | 345 9 0 | |
| | | | Other Publications ... ... ... | 474 3 6 | |
| | | | | | 6,036 14 11 |
| | | | ,, *Government Grants:* | | |
| | | | Government of Bombay ... ... | 4,000 0 0 | |
| | | | Government of India ... ... ... | Nil | |
| | | | | | 4,000 0 0 |
| | | | ,, Interest on Investments (Net) ... ... | | 4,091 15 0 |
| Total ... | | 37,593 6 8 | Total ... | | 37,593 6 8 |

## *PUBLICATIONS*

| | Rs A P | Rs A P | | Rs A P | Rs A P |
|---|---|---|---|---|---|
| *Book of Indian Animals* | | | | | |
| To Stock on 1 January 1954 ... ... | | 3,481 0 0 | By Sales during the year ... ... ... | | 3,655 4 2 |
| ,, Royalties to Author ... ... ... | | 222 0 0 | ,, Stock on 31 December 195 ... ... | | 2,374 0 |
| ,, Sundry Charges—Packing, etc. ... ... | | 228 0 6 | | | |
| ,, Profit transferred to Income and Expenditure Account ... ... ... | | 2,098 3 8 | | | |
| Total ... | | 6,029 4 2 | Total ... | | 6,029 4 2 |

## *Dr.* INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1954—(*continued*) *Cr.*

| EXPENDITURE | Rs A P | Rs A P | INCOME | Rs A P | Rs A P |
|---|---|---|---|---|---|
| *Circumventing the Mahseer and Other Sporting Fish in India* | | | | | |
| To Stock on 1 January 1954 ... ... | | 1,241 0 0 | By Sales during the year ... ... ... | | 600 10 0 |
| ,, Royalties to Author ... ... | | 66 0 0 | ,, Stock on 31 December 1954 ... ... | | 1,112 0 0 |
| ,, Sundry Charges—Packing, etc. ... | | 63 11 0 | | | |
| ,, Profit transferred to Income and Expenditure Account ... ... ... | | 341 15 0 | Total ... | | 1,712 10 0 |
| Total ... | | 1,712 10 0 | | | |
| *Game Birds of India*—Vol. III | | | | | |
| To Stock on 1 January 1954 | | | By Sales during the year ... ... ... | | 289 14 0 |
| Bound copies ... ... ... | 535 0 0 | | ,, Stock on 31 December 1954 | | |
| Unbound copies ... ... ... | 1,350 0 0 | | Bound copies ... ... ... ... | 437 0 0 | |
| | | 1,885 0 0 | Unbound copies ... ... ... | 1,350 0 0 | 1,787 0 0 |
| ,, Sundry Charges—Packing, etc. ... ... | | 64 1 0 | | | |
| ,, Royalties to Author ... ... ... | | 113 0 0 | Total ... | | 2,076 14 0 |
| ,, Profit transferred to Income and Expenditure Account ... ... ... | | 14 13 0 | | | |
| Total ... | | 2,076 14 0 | | | |
| *Indian Molluscs* | | | | | |
| To Stock on 1 January 1954 ... ... ... | | 1,646 0 0 | By Sales during the year ... ... ... | | 86 11 0 |
| ,, Sundry Charges—Packing etc. ... ... | | 6 2 0 | ,, Stock on 31 December 1954 ... ... | | 1,617 0 0 |
| ,, Profit transferred to Income and Expenditure Account ... ... ... | | 51 9 0 | Total ... | | 1,703 11 0 |
| Total ... | | 1,703 11 0 | | | |
| *Bird Picture Postcards* | | | | | |
| To Stock on 1 January 1954 ... ... | | 37 0 0 | By Sales during the year ... ... ... | | 117 11 0 |
| ,, Sundry Charges ... ... ... | | 2 1 6 | Total ... | | 117 11 0 |
| ,, Profit transferred to Income and Expenditure Account ... ... ... | | 78 9 6 | | | |
| Total ... | | 117 11 0 | | | |
| *Nature Calendar* 1955 | | | | | |
| To Cost of Printing, etc. ... ... ... | | 4,061 11 3 | By Sales during the year ... ... ... | | 7,245 3 6 |
| ,, Sundry Charges—Packing, etc. ... ... | | 559 14 0 | | | |
| ,, Profit transferred to Income and Expenditure Account ... ... ... | | 2,623 10 3 | | | |
| Total ... | | 7,245 3 6 | Total ... | | 7,245 3 6 |

BOMBAY, *14th May, 1955.*

(Sd.) A. F. FERGUSON & Co.,
*Chartered Accountants.*

# BOMBAY NATURAL HISTORY SOCIETY

## *NATURE EDUCATION SCHEME*

### *Receipts and Payments Account for the Year ended 31 December 1954*

| RECEIPTS | Rs | A | P | PAYMENTS | Rs | A | P |
|---|---|---|---|---|---|---|---|
| To Balance with the Society on 1January 1954 ... ... | 3,565 | 6 | 0 | By Cost of Nature Study Pamphlets ... ... .. | 2,045 | 0 | 0 |
| ,, Grant from Government of Bombay 1954/55 ... ... ... ... | ... | | | ,, Salary of Nature Education Organiser ... ... | 4,740 | | 0 |
| | | | | ,, Postage ... ... ... ... ... | 193 | 6 | 3 |
| | | | | ,, General Expenses (Stationery, Conveyance, etc.) ... | 315 | 5 | 0 |
| ,, Nature Study Pamphlets—Sales ... ... ... | 345 | 7 | 0 | | | | |
| ,, Balance due to the Society ... ... ... | 3,382 | 14 | 3 | | | | |
| Total ... | 7,293 | 11 | 3 | Total ... | 7,293 | 11 | 3 |

BOMBAY, *14th May, 1955*

(Sd.) A. F. FERGUSON & CO.,
*Chartered Accountants.*

# MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD IN THE HALL OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY, TOWN HALL, HORNIMAN CIRCLE, BOMBAY, ON MONDAY THE 29th AUGUST 1955 AT 5-30 p.m. WITH REV. FR. H. SANTAPAU, S.J., IN THE CHAIR.

1. The Honorary Secretaries' Report for the year ended 31 December 1954 having been circulated was taken as read. The Jt. Honorary Secretary then enumerated the activities of the Society during the period January to August 1955.

2. The balance sheet and statement of accounts presented by the Honorary Treasurer were approved and adopted.

3. The Committee's nominations to the Executive and Advisory Committees, as previously circulated to members, were accepted.

After the normal business of the meeting concluded, Mr. Humayun Abdulali, the Hon. Secretary, moved the vote of thanks to the Chairman.

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EDITORS: SALIM ALI, AND H. SANTAPAU
114 APOLLO STREET, FORT, BOMBAY

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1. Papers which have at the same time been offered for publication to other journals or periodicals, or have already been published elsewhere, should not be submitted.

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3. All scientific names, to be printed in italics, should be underlined. Both in zoological and in botanical references only the initial letter of the genus is capitalized. The specific and sub-specific names always begin with a small letter even if they refer to a person or a place, e.g. *Anthus hodgsoni hodgsoni* or *Streptopelia chinensis suratensis* or *Dimeria blatteri*.

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7. References to literature should be placed at the end of the paper, alphabetically arranged under author's name with the abridged titles of journals or periodicals underlined (italics), and titles of books *not* underlined (roman type), thus:

Roepke, W. (1949); The Genus Nyctemera Hübner. *Trans. ent. Soc. Lond.*, **100** (2): 47-70.

Prater, S. H. (1948); The Book of Indian Animals, Bombay.

Titles of papers should not be underlined.

8. Reference to literature in the text should be made by quoting the author's name and year of publication, thus: (Roepke, 1949).

9. *Synopsis*: As recommended by the Royal Society Scientific Information Conference (July 1948), the editors consider it desirable that each scientific paper be accompanied by a synopsis appearing at the beginning, immediately after the title. The synopsis should be factual. It should convey briefly the content of the paper; draw attention to all new information and to the author's main conclusions. It should also indicate newly observed facts, the method and conclusions of an experiment, and if possible the essential points of any new finding, theory or technique. It should be concise and normally not exceed 200 words.

When the synopsis is completed it should be carefully revised by the author to clarify obscurities, and further compressed wherever possible without detracting from its usefulness.

114 Apollo Street, Fort,
Bombay 1

EDITORS,
*JOURNAL OF THE BOMBAY NATURAL HISTORY SOCIETY*

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# JOURNAL OF THE
# BOMBAY NATURAL HISTORY SOCIETY

Vol. 53, No. 3

*Editors*
SÁLIM ALI & H. SANTAPAU, S.J.

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# A CONTRIBUTION TO THE ORNITHOLOGY OF GARHWAL[1]

BY

K. S. Lavkumar

(*With a map and two plates*)

In this essay I propose to deal with the Alakananda Valley above Rudra Prayag, the Mandakini Valley and the Dhauli Ganga Valley which drains a large portion of eastern Garhwal. The southern regions of Garhwal and the Rishi Ganga flowing down from the Nanda Devi Sanctuary are not included since I have not had the opportunity of visiting them. The Sanctuary being a remarkable valley, surrounded by a formidable ring of snow mountains, requires considerable time and effort to visit, and merits a paper all to itself. Southern Garhwal consists of the foothills south of the Alakananda River and would not differ very appreciably from the Mussoorie hills. It is the three valleys mentioned above that are interesting, leading as they do to the high regions below the perpetual snows and the red hills of the Zasker Range on the border of Tibet.

It is obvious that to be able to comprehend the status of bird life in any region properly it is necessary to consider the ecological factors that so predominantly influence the biological world. The geographical position, topography, the annual precipitation etc. are all very important. However, it is not possible to go into all the aspects of the ornithology of a region like Garhwal in the limited scope of this paper and without a more profound study than I can claim to have made. This article is just a preliminary, and I hope that some readers may find it interesting enough and an incentive to follow up the study of Himalayan birds along any paths it may suggest. Since the entire area was covered in such a short period, namely May and June, and most of that time spent on the march, many species have got left out which otherwise would have made my list of birds more complete.

Although the dividing line between the drier West Himalayan and the more humid East Himalayan sub-specific regions lies somewhere in Nepal, Garhwal is favourably enough placed near the transitional zone

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[1] See also the very useful complementary paper 'A Note on the Nidification and Habits of some Birds in British Garhwal' by A. E. Osmaston. *JBNHS*, Vol. 28 : pp. 140-160, December 1921—Eds.

AUG 7 1956

between the two. Laughing-thrushes which in the Simla hills are not common except in the thickest forest are very frequent here. The Red-headed Trogon, formerly believed to occur as far west as Almora only, was seen by me in fair numbers in forest at the base of Tungnath mountain, and there is no reason to believe that more examples of this kind cannot be revealed by a careful survey.

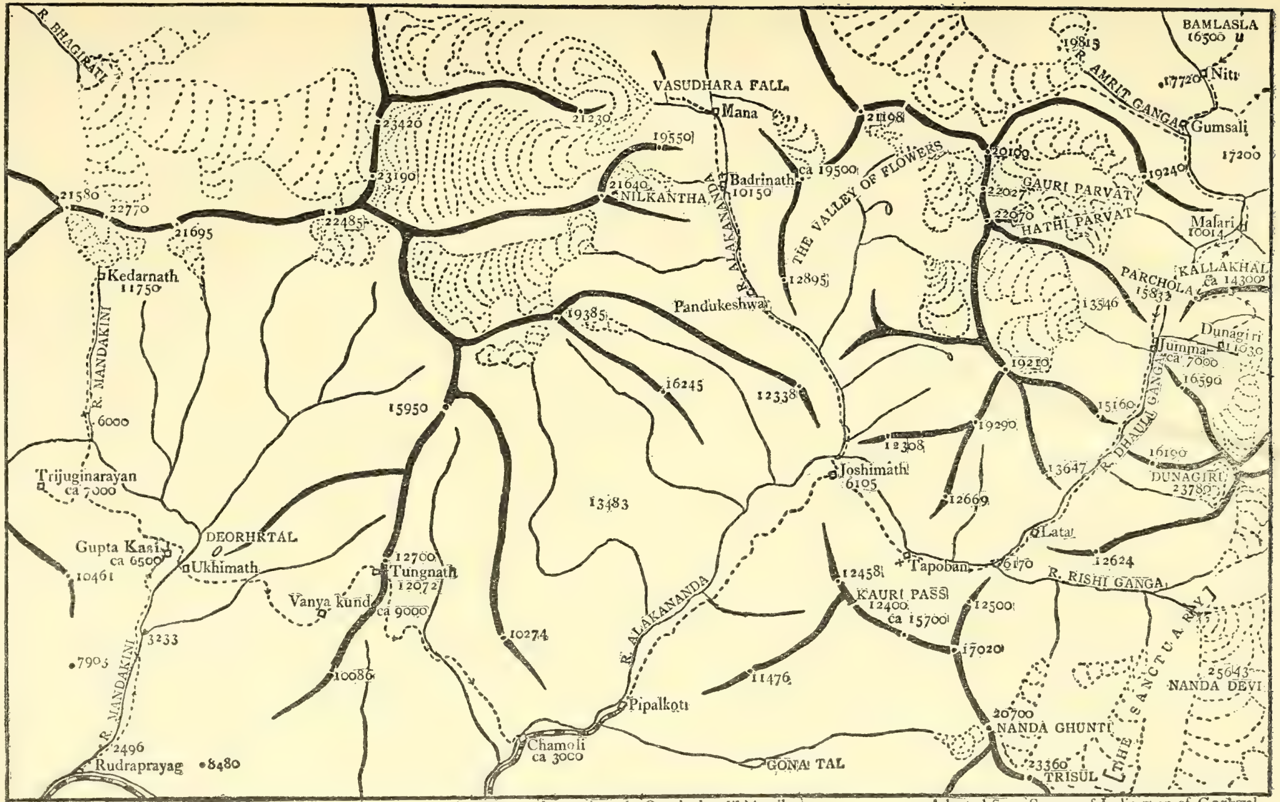
From geographic and climatic considerations, the region under mention can be most conveniently divided into three zones, viz., the Mandakini Valley to the west, the Alakananda Valley and the Dhauli Ganga Valley to the east. These three valleys, due to the configuration of the mountain ranges, have a rainfall heavier in the west and less so in the east, which is absolutely at variance with the general trend in the Himalayas. The reasons will be clearer when each zone is discussed individually. Another very important factor is the great difference in altitude met with here, giving climatic types ranging from tropical heat to the frigid cold of the perpetual snows. In the lower Mandakini a traveller will find fine topes of mangoes ringing to the calls of koels and Indian orioles with a backdrop of snow mountains over 20,000 ft. high. The whole effect is stupendous, and with one sweep of the eye I saw a slope of cultivation ranging from fields in the grasp of a parched summer, through ripe winter wheat followed by those still green with spring wheat, to those just released from the frosty hand of winter. Thus in the span of a few miles live spotted doves of the Indian plains and snow pigeons of the glacier edges, and whereas a king vulture of the lowlands may soar abreast of the observer at 10,000 ft. the lordly lämmergeier of lofty crags will course down a ravine, below one, at 3,000 ft.

## The Mandakini Valley

Draining a section of the southern face of the main Himalayan axis, the Mandakini and her tributaries quickly flow down to six thousand feet, being less than three thousand feet elevation at her confluence with the Alakananda at Rudra Prayag. Till Gupta Kashi the pilgrim track passes through dry subtropical deciduous forest and is shaded by gracious mangoes and peepal trees. The birds here met with are golden orioles, koels, ring doves, spotted doves, Franklin's wren-warblers and the like. At Gupta Kashi the path rises suddenly and zig zags up to six thousand feet; keeping between the six thousand and seven thousand foot contours for most of the way, it rapidly ascends within nine miles to reach Kedarnath at 11,700 ft.

The general trend of the valley is from north to south giving free access to the rain-bearing winds. Consequently the rainfall is very high and the forest biotope from six thousand upwards is of broad-leafed trees, oak being the dominant. Above 7,000 ft. the red flowering *Rhododendron arboreum* and above 8,000 ft. spruce (*Picea morinda*) constitute the chief co-dominants. A sombre spruce forest covers the watershed range of the Mandakini and the Bhagirathi river systems. Pendant moss drapes the tree trunks, and ferns form a rank undergrowth. The chir (*Pinus longifolia*) grows on certain spurs, exposed to the sun at lower heights.

The Tungnath mountain to the east rises to 12,500 ft. above the lesser foothills providing a sweeping view of the snowy mountains of the entire Garhwal. Warm air from the tropical valleys at its base quickly melts the snow and a thick oak forest clothes the slopes right up to 11,000 ft.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R. ALAKANANDA
Badrinath 10150
ca 19500
THE VALLEY OF FLOWERS
22027 GAURI PARVAT
22070 HATHI PARVAT
Malari 10014
KALLAKHAL ca 14300
PARCHOLA 15832
Kedarnath 11750
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Pandukeshwar
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Dunagiri 11030
Jumma ca 7000
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R. MANDAKINI
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Joshimath 6105
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Gupta Kasi ca 6500
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R. RISHI GANGA
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KAURI PASS 12400 ca 15700
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R. ALAKANANDA
THE SANCTUARY
3233
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10086
11476
25643 NANDA DEVI
Pipalkoti
20700 NANDA GHUNTI
R. MANDAKINI
2496
Rudraprayag
8480
Chamoli ca 3000
GONAI TAL
23360 TRISUL

Drawn by author

SCALE Approximately One inch = Eight miles

Adapted from Survey of India map of Garhwal.

# GARHWAL

LEGEND

Hotsprings +

Motor Road

Author's Route

LEGEND

Mountain Ranges with heights in feet,

Pass

Glaciers

Undergrowth is very dense providing shelter to innumerable pheasants; and trogons are fairly plentiful in the branches overhead. The tree-line is girt by lilac-flowering bushes of *Rhododendron campanulatum.* This lovely rhododendron is scarce around Kedarnath, though in all the side valleys to the east it is common.

## THE ALAKANANDA VALLEY

The Alakananda River for most of its length from Joshimath to Rudra Prayag flows in an east-west direction, and the valley has a close resemblance to the Sutlej Valley. The northern slopes are steep and devoid of any forest except in the narrow side-streams, while those to the south are more gentle, bearing fine stands of conifers consisting of deodar (*Cedrus deodara*), blue pine (*Pinus excelsa*), and, on the lower slopes, chir pine. Till Pipalkoti, the bus terminus, however, there are few trees and it is difficult to find shade from the mid-day sun. There is a great need for reforestation on these lower slopes. At Joshimath there is very intense cultivation, but good oak exists higher up. Near here is Vishnu Prayag where the Dhauli Ganga meets the mother stream. Almost till Badrinath the road runs along the river through a deep, narrow gorge, what the geographers call a re-entrant. The valley floor now rapidly gains altitude and wherever the cliffs recede there are fine forests of deodar, horsechestnut and maple. A mile below the shrine, the track climbs what must be the terminal moraine of an extinct glacier. The valley floor from here on is very broad and the three miles to Mana village pass through cultivated fields surrounded by stone walls. Rain-bearing clouds fail to push up the re-entrant, and thus it is very dry and dusty. Desiccating winds from the Tibetan plateau force the snow-line higher than at Kedarnath. The alps at 12,000 ft., however, provide good pastures as do the meadows at the snout of the Satopanth Glacier and the scriptural source of the Alakananda—the Vasudhara Falls, where the valley is strewn with debris from crumbling cliffs, and thickets of wild rose, give security to rosefinches and shortwings. Juniper appears for the first time to be common on the mountains at 13,000 ft. Monals and snowcocks are plentiful above the shrine, and great flocks of both species of choughs wheel about in the sky overhead.

## THE DHAULI GANGA VALLEY

This river system drains some of the noblest snow mountains in the world: Kamet, Mana, Hathi Parvat, Lampak, Hardev, Changabang, Dunagiri, Nanda Devi and Trisul to mention a few of the highest. The main gorge, for most of its length, is deep and steep-sided: a fantastic creation in rock. Till the Rishi gorge the forest is a continuation of the Alakananda type: oak, deodar, and blue pine. It progressively starts getting drier with the great Nanda Devi group of mountains to the south barring passage to the monsoon winds, and the forest is of weathered *Thuja* sp., a conifer of very untidy growth. Bird life is scarce, and for birds the middle reaches of the Dhauli are very uninteresting. Some very fine side-streams, however, flow into the Dhauli within this stretch, the largest of which is the Dunagiri Ghad. A trail leads up through excellent deodar and blue pine timber to the village of Dunagiri at 12,000 ft. situated in meadows filled with flowers and edged by thickets of *R. campanulatum* and birch (*Betula utilis*). All around are breath-taking views of great mountains. The villagers .raise a fine quality of potato, which are transported down to Joshimath on goats and sheep.

At Malari 10,000 ft. the main axis of the Himalayas is left behind and the traveller finds himself in the red mountains of the Zasker Range. The contours recede giving wide views of arid juniper-studded slopes scarred by landslides. A few deodars at Malari, a mixed stand of deodar and blue pine along the bend of the river near Bampa, and some blue pine at Temmersain are all that remain of the forest that once shaded these mountains. Wild roses grow in profusion around the fields. Rose-finches are common, and the screes abound with accentors. Snowcock and wild sheep inhabit the fringe of the snow.

West of Gamsali is a beautiful valley called the Amrit Ganga. On its shingle fed a pair of ibisbills, and among the rocks wagtails had nests, while Hodgson's pipits soared in nuptial flights. Red, orange and yellow pontentillas carpeted the turf and, protected from the dust raising gales of the main valley, snow lingered on longer than elsewhere. Though summer had been heralded by the Asiatic cuckoo at 14,000 ft. on the Kalla khal, here at the same height male blue-fronted redstarts had just arrived, and were staking out territories among snow-filled gullies.

There are clearly marked differences between the forest biotopes of the Mandakini and Alakananda valley systems which reflect directly upon the respective bird distributions in the two. On more sunny features birds will be found higher than on shaded slopes, much as snow lingers considerably more on the latter than on the former. The precise relationship of the various factors of altitude, slope etc. requires a very careful investigation. In addition to these there is the intrusion of man at all heights where cultivation is possible, and this introduces a new factor in the ecological set up. For the most part, it proves a destructive element affecting the delicate balance arrived at by nature through thousands of centuries of evolution. Erosion, resulting from faulty terracing, causes very severe damage to the steep slopes which are a characteristic feature of these mountains, and in time these have become not only useless for cultivation but the exposed parent rock renders them incapable of bearing the former vegetation, and at best they now carry only tangled shrubs of a thorny nature. Fortunately the very softness of the Himalayan rock, which accelerates the rate of erosion, appears to be of great value in rapid reforestation if properly undertaken as has been done in several places in the Mandakini Valley by the forest department. On the great rivers of the Himalayas depend the millions of people living in the Gangetic plain. Severe deforestation permits quick flow of water down the slopes, gathering momentum to create havoc, spreading floods in the low-lands at the foot of the mountains. The prime need therefore is to stop this despoiling of Himalayan forests. There is little doubt that an enlightened reforestation programme would solve the problem of erosion that is systematically making these hills sterile and incapable of sustaining anything valuable to man or animals.

I am greatly indebted to Mr. Gurdial Singh of the Doon School, Dehra Dun, for having introduced me to the truly Alpine heights above 12,000 ft. This has opened up a sphere far beyond limits I had ever hoped to explore.

THE DHAULI GANGA BELOW JUMMA:
A fierce gorge, very dry and devoid of much tree-growth. The side valleys, however, have fine forests.

(*Photo: K. S. Lavkumar*)

THE AMRIT GANGA: Sheep are pastured here on broad meadows. Hodgson's Pipits were breeding here.

## LIST

**Corvus macrorhynchos.** Jungle Crow.

Common throughout the area in all types of country. Saw some circling overhead at 14,000 ft. in the Amrit Ganga Valley. It is likely that birds above 6,000 ft. may be the Carrion Crow, *C. corone*. They appeared to be larger with a distinctly wedged tail.

**Urocissa erythrorhyncha.** Redbilled Blue Magpie.

Common around edges of cultivation and in forest from 5,000 to 8,000 ft. A pair building nest near Ukhimath, May. These magpies are great mimickers, and one very realistically copied the challenge call of the Whitecrested Kalij Pheasant.

**Urocissa flavirostris.** Yellowbilled Blue Magpie.

Distribution almost identical with that of the last species, only that it keeps to higher country and thicker forest.

**Dendrocitta formosae.** Himalayan Treepie.

A bird of cultivation and oak forest from the level of the plains to about 6,000 ft.

**Garrulus lanceolatus.** Blackthroated Jay.

Very common in broad-leaved forests of the Mandakini Valley and on the Tungnath Mountain. Several birds flew down to pick up insects from the surface of the water at Deohra Tal in company with the next species. A pair with food in bill in dense forest at 7,000 ft.

**Garrulus bispecularis.** Himalayan Jay.

Keeps to thicker forest than the last species, but common in suitable forest especially in rhododendron thickets around the Deohra Tal.

**Nucifraga caryocatactes.** Himalayan Nutcracker.

Only a single bird seen in chir pine at about 4,000 ft. near Pipalkoti. These are birds of coniferous forests and must be very scarce in the Mandakini Valley, though they may prove to be common in the other two.

**Pyrrhocorax pyrrhocorax.** Redbilled Chough.

A bird of the rugged mountains above 10,000 ft. though it comes down much lower to feed. Common at Kedarnath, Badrinath and in the Dhauli Valley, where a few pairs were seen near Lata. Also Dunagiri.

**Pyrrhocorax graculus.** Yellowbilled Chough.

Same as the red-billed species. Very common near the Vasudhara Falls and in the upper Dhauli at Bampa, and on the Chor Hoti pass, 17,850 ft. and the Marchok La, 18,250 ft.

**Parus monticolus.** Greenbacked Tit.

Scarce in the Mandakini Valley, but common in the other two above 6,000 and up to 8,000 ft.

**Lophophanes melanolophus.** Crested Black Tit.

Very common in both broad-leaved and coniferous forest above 7,000 ft., almost up to tree-line. Freely breeding at 9,000 ft., at Vanyakund on the Tungnath Mountain in holes of gnarled oaks. Young in nest, May. Parents followed by young at Bampa, June.

**Machlolophus xanthogenys.** Yellowcheeked Tit.

Common in the lower Mandakini and in forest around Ukhimath, up to 5,000 ft.

**Aegithaliscus concinnus.** Redheaded Tit.

Not common in the Mandakini, but frequently seen with hunting parties of small birds, chiefly in deodar and blue pine forest in the other two valleys. Not met above 8,000 ft.

**Sitta himalayensis.** Whitetailed Nuthatch.

Singly or in small parties in forest on Tungnath Mountain. Common.

**Sitta leucopsis.** Whitecheeked Nuthatch.

A single specimen in deodar forest, Dunagiri Ghad, at 9,000 ft.

**Garrulax leucolophus.** Whitecrested Laughing-thrush.

Fairly common in the dry deciduous forest of the lower Mandakini, in small parties.

**Garrulax albogularis.** Whitethroated Laughing-thrush.

Common in forest undergrowth above Trijugi Narayan, around Deohra Tal and Tungnath Mountain right up to the very tree-line. Very confiding as they rummage among the mulch on the forest floor.

**Trochalopteron erythrocephalum.** Redheaded Laughing-thrush.

Not uncommon among undergrowth and in shrubs along streams, from 6,000 ft. to the edge of the tree-line. Singly and in pairs.

**Trochalopteron lineatum.** Streaked Laughing-thrush.

Common in cultivation at medium altitudes. Scarce at 8,000 ft.

**Grammatoptila striata.** Striated Laughing-thrush.

A bird of thick under-shrubs in dense forest at 6,000 ft. in the Mandakini Valley. Not uncommon, but difficult to see due to its skulking habits.

**Turdoides terricolor.** Jungle Babbler.

A small party in the Mandakini Valley in a field hedge at 6,000 ft.

**Pomatorhinus erythrogenys.** Rustycheeked Scimitar-babbler.

Fairly common in forest at 6,000 ft. in the Mandakini, where its liquid call can be heard everywhere.

**Leioptila capistrata.** Blackheaded Sibia.

Its loud trilling call heard in all types of forest at medium heights. Carrying food for young, May—at 6,000 ft.

**Microscelis psaroides.** Himalayan Black Bulbul.

Noisy flocks in all types of forest in the Mandakini Valley at medium altitudes. Seemed to prefer the chir and oak interfacies.

**Molpastes cafer.** Redvented Bulbul.

Met with upto 6,000 ft., in cultivation and in light forest at the edges of terraced slopes. Not common.

**Molpastes leucogenys (leucogenys).** Whitecheeked Bulbul.

Generally distributed up to 7,000 ft. throughout Garhwal, except in very dense forest.

**Certhia himalayana.** Himalayan Tree-creeper.

Apparently absent in oak forest. Seen only at Vanyakund in mixed forest. Not met with elsewhere in the Mandakini. In the other two valleys fairly common in conifer and temperate broad-leaved forest. A bird carrying nesting material at 9,000 ft. on Tungnath Mountain, May.

**Tichodroma muraria.** Wall-creeper.

Common on cliffs and rocks above Mana at 13,000 ft., and above Bampa. Haunts precipitous country.

**Cinclus pallasi.** Indian Brown Dipper.

Common on all the rivers and streams up to 11,700 ft. at Kedarnath, and at 12,000 ft. on the Amrit Ganga at Daldungi camping ground. Breeding was progressing at various stages on the Mandakini. Juvenile birds seen at 6,000 ft., young with their parents a little higher, and birds carrying food to nestlings at 9,000 ft., May.

**Hodgsonius phoenicuroides.** Hodgson's Shortwing.

Common in thickets at 10,000 ft., and higher, both in the Alakananda and the Dhauli valleys. A great skulker, and rarely seen unless followed up by the loud whistle of the male.

**Saxicola caprata.** Indian Stonechat.

Generally distributed in cultivation and on grassy slopes from 3,000 to 7,000 ft. Breeding around Joshimath in June.

**Rhodophila ferrea.** Dark-grey Bushchat.

Common in Garhwal up to 10,000 ft., in cultivation and forest clearings.

**Microcichla scouleri.** Little Forktail.

Seen once on the Mandakini at 9,000 ft.

**Phoenicurus frontalis.** Bluefronted Redstart.

A redstart of the high Himalayas common above 10,000 feet in the Alakananda and the Dhauli Valleys, where they are met with right up to 14,500 ft. Breeding above Badrinath and at Bampa, where a pair had nested under the eaves of a house. A single male flitting over snow drifts at Kedarnath.

**Phoenicurus erythrogaster grandis.** Güldenstadt's Redstart.

A single bird at 16,000 ft. below the Bamlas La in the Dhauli Valley. A redstart of great heights.

**Chaimarrhornis leucocephalus.** Whitecapped Redstart.

A familiar bird of Himalayan streams above 8,000 ft. Breeding under eaves of a house in Badrinath, June, and in the Amrit Ganga Valley at 12,500 ft.

**Rhyacornis fuliginosus.** Plumbeous Redstart.

Common at all heights above 3,000 ft. and up to 12,000 ft. on the Amrit Ganga. Breeding in progress in the Mandakini Valley; young in nest under eaves of a house at Gaurikund 6,000 ft., and a nest under construction in river bank at 9,000 ft.

**Calliope pectoralis.** Himalayan Rubythroat.

A bird of the boulder-strewn Himalayan slopes above 10,000 ft. Common in the upper Alakananda, at Temmersain, and around the village of Dunagiri. The male sings perched exposed on some large boulder.

**Tarsiger brunnea.** Indian Blue Chat.

Keeps to dense cover in forest and in open shrubberies at its edge, above 6,000 ft. Very difficult to see, but the male has a loud and intriguing whistle which gives away his presence.

**Tarsiger chrysaeus.** Golden Bush-robin.

A pair at 11,000 ft. in the Mandakini Valley, restricted to a patch of scrub, where I saw the magain after four days on the return from Kedarnath. Very confiding.

**Adelura caeruleocephala.** Blueheaded Robin.

A pair in deodar forest at 8,000 ft. in the Dunagiri Ghad. Very agitated at my presence and undoubtedly had young in the vicinity. June.

**Copsychus saularis.** Indian Magpie-robin.

Not uncommon in the lower Mandakini up to Gupta Kashi.

**Turdus albocinctus.** Whitecollared Blackbird.

Common above 7,000 ft. in the Mandakini. Breeding at Vanyakund on the Tungnath Mountain at 9,000 ft. The male sings before and after dawn and dusk respectively.

**Turdus boulboul** Greywinged Blackbird.

A bird of lower altitudes than the last species. Common in the broadleaved forest of the Tungnath Mountain where it was breeding at 6,000 ft.

**Turdus viscivorus.** Himalayan Mistle-thrush.

Very numerous above 8,000 ft. both in forest and on meadows. Also on high alps at 12,000 ft. on Tungnath Mountain.

**Monticola erythrogastra.** Chestnutbellied Rock-thrush.

A male singing in high oak forest near the tree-line at 11,000 ft., below Tungnath shrine.

**Monticola solitaria.** Blue Rock-thrush.

A single male seen by Gurdial Singh at over 16,000 ft. above Temmersain in the Dhauli Valley. To me this bird seems to have a very erratic distribution in the Himalayas. Both here and in Nepal [*vide JBNHS*, Vol. 53 (1): 32] it appears to live at great altitudes on the driest of slopes or cliffs, whereas in the Simla hills I found it very common on the cliffs overhanging the Narkanda road between Fagu and Theog.

**Monticola cinclorhyncha.** Blueheaded Rock-thrush.

A bird of the chief forest and rocky grass-covered slopes between Pipalkoti and Joshimath. Common. Perching freely on the telegraph wires. Male's display song heard throughout the day.

**Myiophoneus temminckii.** Himalayan Whistling-thrush.

One of the few birds impartial to heights, from the foot of the mountains to the snow slopes of Kedarnath at 11,500 ft. On all rivers and streams as well as in oak forest bordering flowing water of any size. A bird carrying food to nest just above the swirling waters of the Dhauli near Jummagwar, June.

**Laiscopus collaris.** Alpine Accentor.

Common on the inner Himalayas above 13,000 ft. on the edge of snow fields. Seems to prefer scree-covered slopes to smooth alpine meadows.

**Prunella strophiata.** Rufousbreasted Accentor.

A bird of juniper and scree slopes at and above 12,000 ft. Apparently breeding at Temmersain, June.

**Hemichelidon sibirica.** Sooty Flycatcher.

Very plentiful in oak and conifer at 9,000 ft. on the Tungnath Mountain. A bird incubating, May. Nest: a small cup placed on a branch in a very exposed position, high up in a spruce.

**Muscicapula superciliaris.** Whitebrowed Flycatcher.

In all types of forest from 7,000 ft. to 10,000 ft. A pair had young in nest at Vanyakund, May. The nest was high up in a spruce, in a cavity draped with moss.

**Eumyias thalassina.** Verditer Flycatcher.

Generally distributed in forest from 6,000 to 9,000 ft., commonest at 7,000 ft. Seems to prefer broad-leaved forest.

**Cucilicapa ceylonensis.** Greyheaded Flycatcher.

Met with in all types of forest below 8,000 ft. Commonly associates with mixed hunting parties of small birds.

**Tchitrea paradisi.** Paradise Flycatcher.

A pair seen bathing at dusk in the cold water of the Mandakini at 5,000 ft. near Gupta Kashi; the male in full adult plumage.

**Chelidorhynx hypoxantha.** Yellowbellied Fantail Flycatcher.

A family party of this beautiful little bird was seen at 10,000 ft. in rhododendron thickets on Tungnath Mountain.

**Lanius schach.** Rufousbacked Shrike.

A pair at 10,000 ft. near Malari, and another pair in the Pipalkoti dak bungalow compound.

**Pericrocotus brevirostris (or ethologus ?).** Shortbilled Minivet.

A familiar bird of the Himalayan forest up to 9,000 ft. Appears to be commoner in mixed forest. A pair building high up in a blue pine at Vanyakund on Tungnath Mountain, May.

**Dicrurus macrocercus.** Black Drongo.

Seen in the Mandakini up to about 5,000 ft. elevation.

**Dicrurus leucophaeus.** Grey Drongo.

A slim drongo of the hill forest and cultivation edges up to a little above 7,000 ft. Very common.

**Phylloscopus affinis.** Tickell's Leaf-warbler.

From 9,000 ft. up to any height where there is sufficient shrub cover this little bird is common. Dome-shaped nests in thickets at varying heights from the ground. Building at Bampa, June.

**Phylloscopus occipitalis.** Large Crowned Leaf-warbler.

Freely breeding in gnarled oak trees at Vanyakund, May. Most nests had young.

**Phylloscopus.** spp.

A large number of other species of this difficult genus occur in the Himalayas at all heights and in all types of forest and cultivation. A very careful study is required to diagnose the various species accurately.

**Seicercus xanthoschistos.** Greyheaded Flycatcher-warbler.

Very common up to 7,000 ft. in undergrowth in coniferous as well as broad-leaved forest, in all three valleys. Forms cheerful hunting parties with redheaded tits that are such a feature of these Himalayas.

**Suya criniger.** Brown Hill-warbler.

Common on grassy slopes and in cultivation at medium altitudes.

**Oriolus oriolus kundoo.** Indian Oriole.

Plentiful in mango groves of the lower valleys. Its melodious call is the most familiar bird call of these parts.

**Saroglossa spiloptera.** Spottedwinged Stare.

Flocks in cultivation and forest at 6,000 ft. in the Mandakini Valley. Heard of flock at 10,000 ft. near Malari.

**Acridotheres tristis.** Common Myna.

Seen in cultivation up to 6,000 ft. in the Mandakini Valley.

**Pyrrhospiza punicea.** Redbreasted Rosefinch.

A small flock of both sexes at Kedarnath. The birds showed little fear at being watched, and permitted a very close approach. On rising, they flew only a little distance to settle behind some boulders. Kept to the edges of small streams from the melting snows.

**Propasser rhodochrous.** Pinkbrowed Rosefinch.

Kedarnath, Badrinath and in the Dhauli Valley at Bampa, where they freely entered the villages and in all respects replaced the house sparrow of the lower altitudes. This finch seems more free in its habitat than the last, being found along moist turf as well on the driest grass-covered slopes. Freezes on approach, and only if the intruder stands quite still will it start feeding again. Once on the wing, however, it flies fast up the slope for a considerable distance before alighting.

**Carpodacus erythrinus (roseatus).** Common Indian Rosefinch.

Saw none at Kedarnath, though in late July there were quite a number of males in brilliant plumage among the briar thickets above Mana. They had obviously just arrived from their winter quarters and were very shy. In late July, the males were singing beautifully at Bampa and showed little fear of the observer. On the whole they are shier than the last two birds. A party of females at Mandal Chatti in late May. On passage ?

**Metaponia pusilla.** Goldfronted Finch.

Very common in the Dhauli Valley between 8,000 and 12,000 ft. These birds are very much on the move all the time and seldom does an observer get a chance to view them properly in the forest zone. However, at Bampa they settled to glean grass seeds along streams and then could be carefully stalked. At such times they behaved as though completely oblivious of the observer's presence and permitted a very close approach indeed.

**Hypacanthis spinoides.** Himalayan Greenfinch.

A few birds in the Mandakini Valley at about 6,000 ft. in May. They were very common in the Dhauli Valley from Malari to Joshimath in late July, on our return from Tibet.

**Gymnorhis xanthocollis.** Yellowthroated Sparrow.

Below 5,000 ft. in the Mandakini Valley.

**Passer domesticus.** Indian House-sparrow.

Common at most chattis below 6,000 ft. Possibly extending its range into the mountains as it has done in other parts of the Himalayas.

**Passer rutilans.** Cinnamon Tree-sparrow.

In cultivation at 6,000 ft. in the Mandakini Valley. Not very common.

**Montifringilla** sp. Snowfinch.

A single bird seen in flight over snow at 16,000 ft. on the Chor Hoti Pass.

**Fringillauda nemoricola.** Mountain Finch.

Large flocks of sparrow like birds in fields around Mana, but identity as this species unconfirmed.

**Emberiza stewarti.** Whitecapped Bunting.

Males singing from exposed branches in the lower Dhauli Valley. Prefers grass slopes.

**Emberiza cia.** Eastern Meadow Bunting.

Common in the Alakananda Valley in the fields from Badrinath to Mana ; also in the Dhauli Valley around Bampa. Not noted elsewhere.

**Melophus lathami.** Crested Bunting.

Met with in the lower reaches of the Alakananda, in the hot deciduous scrub.

**Delichon urbica.** House Martin.

Solos over Kedarnath at 13,000 ft. in May, at Badrinath at 14,000 ft. and a pair in the Amrit Ganga Valley at 15,000 ft. in June.

**Riparia rupestris.** Crag Martin.

In the Dhauli gorge above Bampa.

**Hirundo smithii.** Wiretailed Swallow.

Noted in the lower Mandakini.

**Hirundo daurica.** Redrumped Swallow.

Common throughout the Himalayas up to 10,000 ft. Breeding in the Mandakini at 5,000 ft. in May.

**Motacilla lugubris.** Hodgson's Pied Wagtail.

In both the eastern valleys above 6,000 ft. Breeding at Daldungi 12,000 ft. in the Amrit Ganga, June.

**Motacilla cinerea.** Eastern Grey Wagtail.

Common in the Dhauli Ganga above Lata. Also above Badrinath ; perching freely on the roofs of Mana houses. Males in full song in early June.

**Anthus roseatus.** Hodgson's Pipit.

Breeding in the Amrit Ganga at 12,000 ft. Common. The male soars up into the air and spirals down to earth singing very much like the red-winged bush-lark. A nest under rocks containing three fledgelings, June.

**Anthus** spp.

Many species of pipits seem to inhabit the grassy slopes above the tree-line and a careful analysis is desirable. The birds so common on the edge of snowfields, both at Kedarnath and Badrinath, were possibly Indian Tree Pipits (*A. hodgsoni*). Nest with three eggs in a tussock of grass at 12,000 ft., Kedarnath, May.

**Zosterops palpebrosa.** Indian White-eye.

Common in the lower Mandakini and at Rudra Prayag.

**Cinnyris asiatica.** Indian Purple Sunbird.

Seen along the Mandakini below Gupta Kashi.

**Dicaeum agile.** Thickbilled Flowerpecker.

A few birds in rhododendron clumps at 10,000 ft. on Tungnath Mountain.

**Picus squamatus.** Scalybellied Green Woodpecker.

Birds seen in oak forest at 7,000 ft.

**Dryobates himalayensis.** Himalayan Pied Woodpecker.

Common in mixed forest at Vanyakund. A bird flushed by a small hawk and then chased right across a valley.

**Dryobates auriceps.** Brownfronted Pied Woodpecker.

A common Himalayan woodpecker below 8,000 ft. throughout Garhwal.

**Vivia innominatus.** Himalayan Speckled Piculet.

In rank shrubberies at 8,000 ft., Dunagiri Ghad. The birds kept to the slender branches only, and uttered the *spit-spit* call all the while.

**Megalaima virens.** Great Himalayan Barbet.

Common everywhere up to 8,000 ft. Its wailing call is a familar bird sound in the Mandakini forests.

**Megalaima lineatus.** Lineated Barbet.

Apparently common in the Mandakini, in forest, at medium altitudes.

**Cuculus conorus (telephonus).** Asiatic Cuckoo.

Its deep musical call is heard on the highest Himalayan meadows.

**Cuculus optatus.** Himalayan Cuckoo.

A coucal-like call, familiar at 9,000 ft.

**Cuculus poliocephalus.** Small Cuckoo.

The shrill cries of this bird were not commonly heard in Garhwal. It keeps to forest on very steep hill-sides.

**Cuculus micropterus.** Indian Cuckoo.

This is a bird of medium altitudes in all types of forest. The call is a high-pitched double *cuckoo-cuckoo.*

**Hierococcyx varius.** Common Hawk-cuckoo.

Common on the hot slopes of the lower valleys.

**Eudynamis scolopaceus.** Koel.

Very common in the lower Mandakini.

**Psittacula himalayana.** Slatyheaded Parakeet.

Large flocks wheeling over forest in the Mandakini at 6,000 ft. Also at Malari at 10,000 ft.

**Harpactes erythrocephalus.** Redheaded Trogon.

Birds flitting in dense forest at 6,500 ft. on Tungnath Mountain.

**Micropus apus.** Eastern Swift.

Large flocks gracefully sweeping over Tungnath Mountain.

**Micropus pacificus.** Blyth's Whiterumped Swift.

Seen over forest on Tungnath Mountain.

**Chaetura caudacatus.** Whitethroated Spinetail.

Huge flocks of large swifts seen over Tungnath Mountain forests were presumably of this species.

**Torgos calvus.** King Vulture.

Common from the foothills to about 7,000 ft. In flight seen even higher up.

**Gyps himalayensis.** Himalayan Griffon.

Up to the highest elevation in the Himalayas. Birds on the Chor Hoti pass 17,850 ft. were very light coloured.

**Pseudogyps benghalensis.** Whitebacked Vulture.

From the level of the plains to 7,000 ft.

**Neophron percnopterus.** White Scavenger Vulture.

Sparingly up to 10,000 ft. at Bampa.

**Gypaëtus barbatus.** Bearded Vulture.

Common at all altitudes. Singly or in pairs gliding along mountain slopes. A pair gave a wonderful display of diving etc. over the summit of Tungnath Mountain.

**Falco severus.** Indian Hobby.

Singly or in pairs throughout Garhwal.

**Falco tinnunculus.** Himalayan Kestrel.

Fairly common along the Badrinath track.

**Aquila chrysaëtus.** Golden Eagle.

An immature bird in flight over Joshimath, and a mature one at 14,000 ft., above Badrinath.

**Ictinaëtus malayensis.** Black Eagle.

A solo at 7,000 ft., in the Mandakini Valley.

**Milvus migrans (lineatus).** Blackeared Kite.

Common at Joshimath. A solo seen in the Amrit Ganga at 12,000 ft.

**Dendrophassa bicincta.** Orangebreasted Green Pigeon.

Commonly heard in broad-leaved forest at 6,000 ft. in the Mandakini Valley.

**Columba livia.** Blue Rock Pigeon.

Pairs in cliff faces. Highest seen at 7,000 ft.

**Columba leuconota.** Snow Pigeon.

Large flocks above 10,000 ft., throughout Garhwal. Commonly seen feeding in fields at Mana and Dunagiri. Breeds in the great cliffs below the snows, and in the river gorges in their upper reaches.

**Streptopelia orientalis.** Rufous Turtle Dove.

Common in hill forest between 5,000 and 8,000 ft. Not seen in cultivation.

**Streptopelia chinensis.** Spotted Dove.

Common along the pilgrim track in the lower Mandakini.

**Streptopelia senegalensis.** Little Brown Dove.

Found at about 3,000 ft. in the lower valleys.

**Streptopelia decaocto.** Indian Ring Dove.

In cultivation in the Mandakini Valley up to 6,000 ft.

**Gennaeus hamiltonii.** Whitecrested Kalij.

A common pheasant of oak forest at medium altitudes. Very confiding along the pilgrim track up Tungnath Mountain. Several other pheasants were heard in thick undergrowth in the Mandakini Valley, but I was unable to sight them satisfactorily enough for correct identification.

**Lophophorus impejanus.** Monal.

Numerous along the tree-line on Tungnath Mountain and above the shrine of Badrinath, and on the slopes above Dunagiri Village. Not met with in the trans-Himalayan valleys of the Zaskers.

**Alectoris graeca.** Chukor.

A bird flushed from a scree at 13,000 ft. above Badrinath.

**Francolinus francolinus.** Black Partridge.

Common in hill cultivation as high as 6,500 ft. Its call is the most familiar bird sound at this altitude.

**Tetraogallus himalayensis.** Himalayan Snowcock.

Plentiful in western Garhwal above Badrinath, and on the higher slopes of the Dhauli Valley, from 12,000 ft. to the very snow-line. A hen with five downy chicks flushed at 15,000 ft. on Parchola. Call a wailing whistle.

**Burhinus oedicnemus.** Stone Plover.

Heard calling at dusk near Mandal Chatti at about 3,500 ft.

**Ibidorhyncha struthersii.** Ibisbill.

A pair of these uncommon birds haunted the shingle beds of the Amrit Ganga at 12,000 ft. Very wary. While feeding it walks with a crouching gait and on the whole resembles a very large edition of the Common Sandpiper.

**Podiceps ruficollis.** The Little Grebe.

A couple of pairs on the Deohra Tal. Very confiding. Courtship display in progress on a mound of earth in the water close to the shore, March.

# BIONOMICS OF THE GIANT WOOD SPIDER, *NEPHILA MACULATA* FABR.

BY

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*Institute of Science, Bombay*

(*With two plates*)

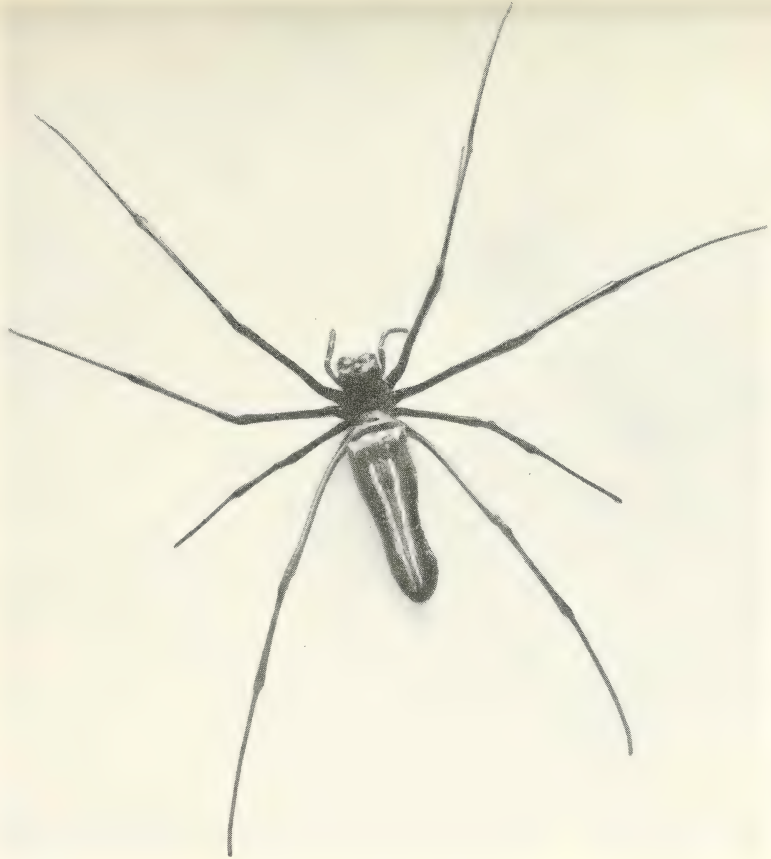
In 1953 the author submitted a thesis on the Anatomy and Bionomics of the Forest Spider, *Nephila maculata* Fabr., to the University of Bombay for the degree of Master of Science in Zoology, under the guidance of Shri V. B. Tembe at the Institute of Science, Bombay.

Work was started in 1950 and completed in 1952, during which time many visits were paid to Borivli and Bassein at the proper season to study the animal in the field. During 1951 and 1952, the author was aided with an annual monetary award by the Bombay Natural History Society for field work in natural history. The present paper is a summary of the thesis submitted to the University, but deals only with the natural history aspects of the animal. The work done on the morphology and anatomy of the spider is omitted here, since it is chiefly of a too technical nature.

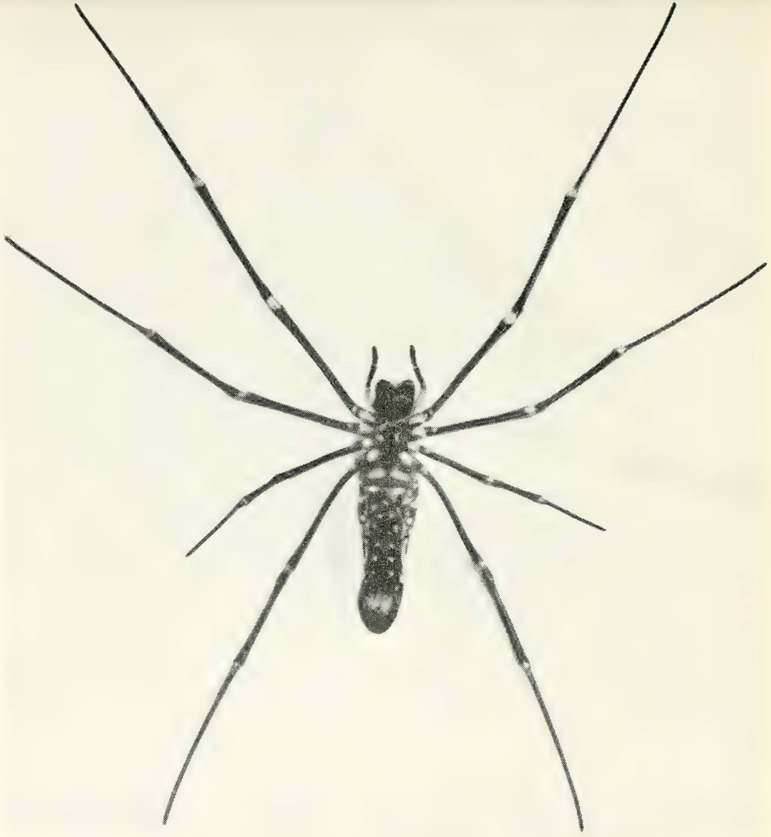
*Nephila maculata,* known as the Forest Spider or Giant Wood Spider, is the largest orb-weaving spider in India. It is dense black in colour with brilliant yellow spots and lines on the abdomen. It is quite commonly seen in the forests of Bombay clinging to the centre of a large circular web woven across an opening through the trees, which may be as much as 6 to 8 ft. in diameter. These webs are stretched vertically between large trees or across a jungle path, at heights varying from 2 to 20 ft. from the ground. The webs may face in any direction of the compass.

A few individuals of this spider may be seen in the last week of August when they first appear; their numbers increase in September, and they are abundant thereafter through the first half of November. They begin to decrease from the second half of November and through December, becoming very rare by the end of the latter month. By the end of January hardly one or two can be seen during a morning's walk where hundreds were present in September and October. No specimens at all were observed near Bombay during other months of the year, though Fischer once noted it near Coimbatore at the end of May, recording it as a very rare instance.

The young of both sexes first appear with their tiny webs towards the end of August and early in September. Their bodies then measure about 1 cm. in length, and the legs have a span of 4 to 5 cm. Their webs, though strikingly similar to those of the adult female, are less than a foot in diameter. The colour of the adult female is dense black with a few whitish patches which gradually turn to bright yellow as she grows. The growth is rapid, and after about four moults the spider reaches its adult size by the end of September when



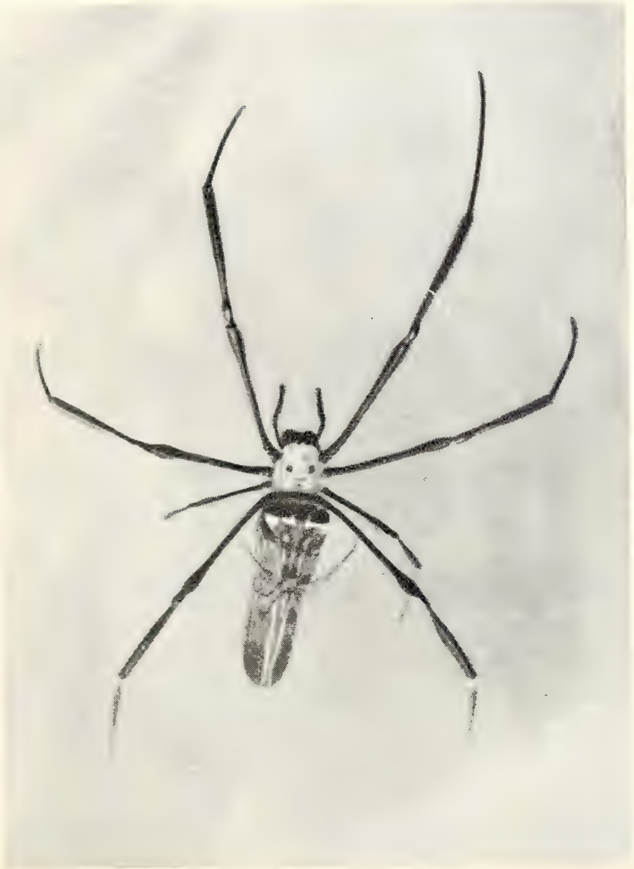
1. Female—dorsal view



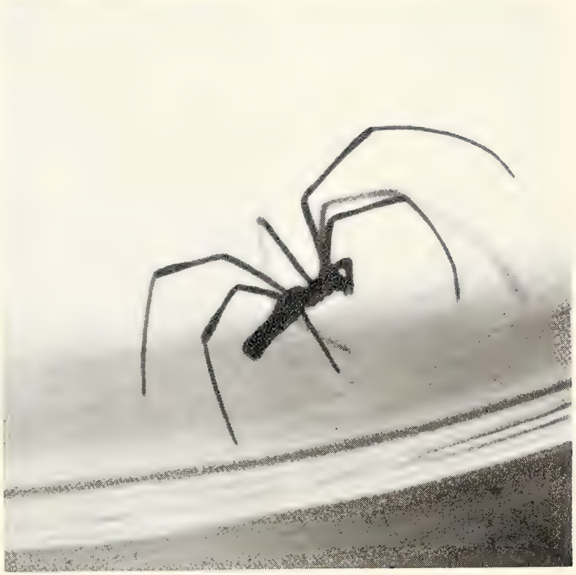
2. Female—ventral view

(*Photos : M. K. Thakur*)

*NEPHILA MACULATA*



1. Female with a male on her back



2. Young male

the body measures about 4 cm. ($1\frac{1}{2}$ in.) in length, and the legs have a span of about 15 cm. (6 in.). In the young female the tibia of the first, second and fourth legs, and the metatarsus of the fourth leg, are covered with tufts of long black hairs. These tufts are never found on the legs of adults, either female or male.

The adult male, which has already been recorded by various workers (Hingston, Gravely, Fischer) as red in colour and inhabiting the web of the female, is very similar to her when young. The young male also constructs a web similar to that of the young female. In size and colour the young male resembles the young female except that his palpus is slightly differently shaped. The male does not increase in size as he grows to maturity, but merely changes in colour from black to brownish red. The palpus, which is somewhat like the beak of a duck, gradually swells at the base, the apex becoming elongated and pointed. At this stage moulting takes place, and this is probably the final or pre-final moult. An adult male kept in a cage in the laboratory was seen to moult during the first week of November, though the above-mentioned changes normally occur at the end of September or early in October.

The male thereafter abandons his own web and wanders forth in search of a mate. Finding the large web of an adult female, he takes up a position in an upper corner of the periphery and waits for a suitable opportunity for copulation. Usually two or three of such 'waiting-on' males are present in each web, but their number may sometimes be as high as seven or eight. The female reaches maturity by the end of September or beginning of October. It is only when she is ready for copulation that the male, for the first time, approaches her. A premature approach may lead to his death. Copulation continues at irregular intervals for a day or two. The male is the active partner in the process, while the female remains passive and seems to have very little interest in the act. The male hardly survives for two or three days afterwards. In many spiders the female devours the male after the sexual act, but in the case of *Nephila maculata* he just dies a natural death, apparently due to exhaustion.

Even when copulation has not taken place, the male normally dies by the beginning of November. It is generally believed that the male spins a delicate web, upon which he emits the seminal fluid, which is afterwards taken up in his own palpus and inserted into the female (Comstock and Savory). This phenomenon was not observed by us in the Giant Wood Spider. The male does construct a web on the back of the female, but this is not used for the transference of the seminal fluid from the genital organs to the *receptaculum seminis* situated in the palpus. The palpi of several males examined before the construction of this web already had seminal fluid in the *receptaculum seminis*. The exact process of transference of the fluid from the seminal vesicle to the palpus could not be observed. It appears that the tip of the palpus (embolus) is applied directly to the external aperture of the seminal vesicle and the fluid sucked in.

The gravid females can be seen in their webs during October and November. When the eggs are ready for laying the female abandons the web and the cocoon is deposited in some well-concealed place.

We never succeeded in finding the eggs in the field, though they are well known from individuals kept in captivity.

The female toils for about two days to construct an egg-sac round her mass of eggs. After completion of this sac, the female sometimes spins a web of a few untidy strands for herself, or she may return to her original web. Thereafter she takes no food, and slowly shrivels up and dies after two or three days, leaving the cocoon to the care of Mother Nature.

In some cases, when the female matures too late in the season and does not find a mate, the unfertilized eggs are laid and the female dies after a couple of days. The fertilized eggs are yellowish white in colour and invariably enclosed in a cocoon, while the unfertilized eggs are black and always left uncovered.

The food of this spider consists almost entirely of butterflies, moths, dragonflies and grasshoppers which are all caught in the web. The spider is otherwise sedentary in habits.

The male, when young, constructs his own web and secures his food independently. After attaining maturity, and after taking up a position in the web of the female, he generally feeds upon small flies and mosquitoes which are entangled in the same web but are too insignificant to attract the female's attention. According to Hingston, the male sometimes snatches away an insect after the female has already entwined it with silk.

If sufficient prey in the form of flying insects does not regularly come to the web, the female migrates to an alternative site, where a new web is constructed. Sometimes a new web facing a different direction is constructed in the same spot. A migration of this kind may be of over 200 yards, though most often the new site is only a short distance away. When a site is thus abandoned, all the silk of the old nest is collected and rolled into a ball which is transported between the chelicerae to the new site. It is said that this is eaten up after the completion of the new web.

The small spider, *Argyrodes nephilae,* of the family Theridiidae is commonly associated with the Giant Wood Spider. From a distance this spider looks like a drop of mercury due to the silver-white of the dorsal surface of its abdomen. It does not appear to spin a web of its own, and habitually feeds on the minute flies and mosquitoes which get entangled in the Giant Wood Spider's snare, but are too insignificant to attract the owner's attention. This spider has a universal distribution, and owes its specific name to the fact that it generally lives in the webs of *Nephila.*

The Garden or 'Bloodsucker' Lizard (*Calotes*) appears to be the commonest natural enemy of this spider. From a near-by twig it jumps on to the web and brings down the spider to the ground where it devours it. Under laboratory conditions these spiders are eaten by geckoes (*Hemidactylus*). The naked unfertilized egg masses were destroyed by ants, but those properly encased in the cocoons appeared safe.

As no details appear to have been published regarding the nature of the silk used by *Nephila* for its web, and on the manner of its production, our observations may prove interesting.

Members of the sub-family Nephilinae, to which *N. maculata* belongs, are well known for the large quantity and the strength of their silk. This spider has five types of silk glands, and the secretion of each gland has a specific use. The silk of the spider can be classified according to its nature and use.

The Web:

The web consists of the following parts: (1) foundation, (2) radii, (3) hub, and (4) viscid spiral thread. The nature and origin of the first three parts is common, while the viscid thread differs from the rest in origin and nature. The foundation lines, radii and the hub along with the temporary spiral are products of the ampullate glands.

Foundation lines:

The foundation line is generally made of about six fibres and about 19 $\mu$ thick. The colour is slightly yellowish.

Radii:

In origin and colour the radius resembles the foundation line. Each line consists of two fibres and is about 9.5 $\mu$ thick.

Hub:

The silk that is used for the hub is the same as that employed for the radii ('spokes').

Spiral thread:

The spiral thread is the line placed in spiral fashion across the radii—connecting the spokes of a wheel, as it were. It is due to this thread that the prey gets entangled in the web. The line consists of two filaments attached together to form the axis, and a series of droplets borne by it at regular intervals. The thread is of an elastic nature, and hence the web does not break when the prey falls against it and struggles to escape. The thread is white in colour and measures 7.5 $\mu$ in thickness. The sticky nature of the thread is due to the droplets borne by the thread. It is probable that the axis is the product of the aggregate gland while the viscid drops are produced by the nodules borne by the duct.

The Drag-line:

The spider, as it moves from place to place, puts out a line of silk to mark its course. This line is termed the drag-line. By means of this line the spider lets itself down from an elevated position to a lower one, or to the ground when disturbed, and also climbs back to its original place. It consists of two fibres and is similar to the radius in colour and origin. It probably comes from the spigots of the fore spinnerets, and, as already stated, is a product of the ampullate glands.

The Attachment disc:

At intervals the dragline is fixed to some object by means of white disc-like structures known as the attachment discs. They are also used for fixing the foundation lines to the support. For making an attachment disc the spider applies the fore spinnerets to the surface, quickly spreads them apart and brings them together again. The disc consists of numerous delicate threads obtained from the spinning tubes of the fore spinnerets. The secretion of the pyriform glands is used for these discs.

### The Swathing band:

The spider envelops its prey with a thin sheet of silk. This sheet consists of numerous fine fibres placed one over the other, and is known as the swathing band. The origin of the swathing band has not yet been definitely determined. It is probable that the silk comes from the middle and the hind spinnerets, and the secretion of the aciniform glands is used for them. But according to Comstock the band comes from all the spinnerets and is the product of both the pyriform and aciniform glands.

### The Egg-sac:

The mass of the eggs is covered over by a cushion of silk. The silk used for the egg-sac is obtained from the cylindrical glands and is pink in colour. The line is simple and consists of a single thread about 6 $\mu$ thick.

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# GEOGRAPHICAL DISTRIBUTION OF THE HALOPHYTIC PLANTS OF BOMBAY AND SALSETTE ISLANDS[1]

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(*With five plates*)

## 1. Introduction

While studying the ecology of the mangrove vegetation from several places in and around Bombay and Salsette Islands, it was thought that it would be interesting to study the geographical distribution of the halophytic plants and the factors governing it. Previously Blatter (2 & 3) studied the mangrove vegetation of Bombay and its biology and Biswas (1) made a comparative study of Indian species of *Avicennia*. Similarly Cooke (5) as well as Talbot (8) have described some of the species in the Flora of the Presidency of Bombay, and in the Trees, Shrubs, and Woody-Climbers of Bombay Presidency respectively. But so far no attempt has been made to record the geographical distribution of the halophytes of Bombay and Salsette Islands. Due to earlier detailed study of rocks, soil-salinity, soil-humidity and biotic factors (6 & 7) it has been possible to study the distribution of these halophytes.

In the present case the mangrove vegetation was studied from several places in and around Bombay, from Colaba reclamation, Vadala, Sewri salt-pans, Worli and Mahim. In Salsette the mangrove vegetation was studied from the following places: Thana, near the creek and along the railway lines on both the sides, marshy places near the creek of Bandra, Bassein, Mire, Ghodbunder, Mumbra, Diva along the railway lines towards the east, and Ghatkoper. Also the marshy places near the islands of Uran, Mora, Dongri, Elephanta and Mudh (near Versova),(Plate I).

The distribution of the mangrove vegetation is chiefly composed of *Avicennia alba* Blume, which seems to be very prolific in growth and germination. It is only in a few places, where the intensity of human influence is not very marked, that we find *Avicennia alba* Blume mixed with other mangrove species such as *A. officinalis* Linn., *Acanthus ilicifolius* Linn., *Ceriops candolleana* Arn., *Aegiceras majus* Gaertn., *Bruguiera gymnorhiza* Lam., *Sonneratia* species, *Rhizophora* species, *Salicornia brachiata* Roxb., *Clerodendrum inerme* Gaertn., *Lumnitzera racemosa* Willd., *Excoecaria agallocha* Linn., etc. This can be clarified from the vegetation between Diva and Mumbra, and along Vadala, Ghodbunder, Bandra, Mahim etc.

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[1] This paper was read in the Botany Section of the 40th Session of the Indian Science Congress, held at Lucknow in 1953.

## 2. NATURAL VEGETATION AND EFFECT OF BIOTIC FACTORS

Animals such as cattle use the marshy vegetation as a source of food supply. Buffaloes and bulls like the young leaves of *Avicennia* species as well as the flowers of *Acanthus ilicifolius*. These animals devour the flowers with relish. The effect of eating the growing shoots of the trees is that the trees begin to spread branches from the sides, and when the young shoots of these branches are again browsed then other branches are spread out of their sides. Thus the plants, instead of growing straight and high, constantly give out branches from the sides to form small bushes. Such bushes are seen near Ghodbunder, Thana, and Mumbra creeks where the young plants are browsed by animals. The poorer residents of these neighbourhoods use the trees or bushes of the marshy vegetation for fuel. (In Karachi it was a regular practice to rent out the mangrove vegetation for fodder for cattle). They generally cut the older plants leaving the younger ones to mature. It has been shown that due to this biotic influence the valuable species of the mangrove vegetation are fast disappearing from the coast of Bombay and Salsette Islands. *Lumnitzera racemosa* Willd., observed on the shores of Bandra in 1933, had disappeared completely in 1934.

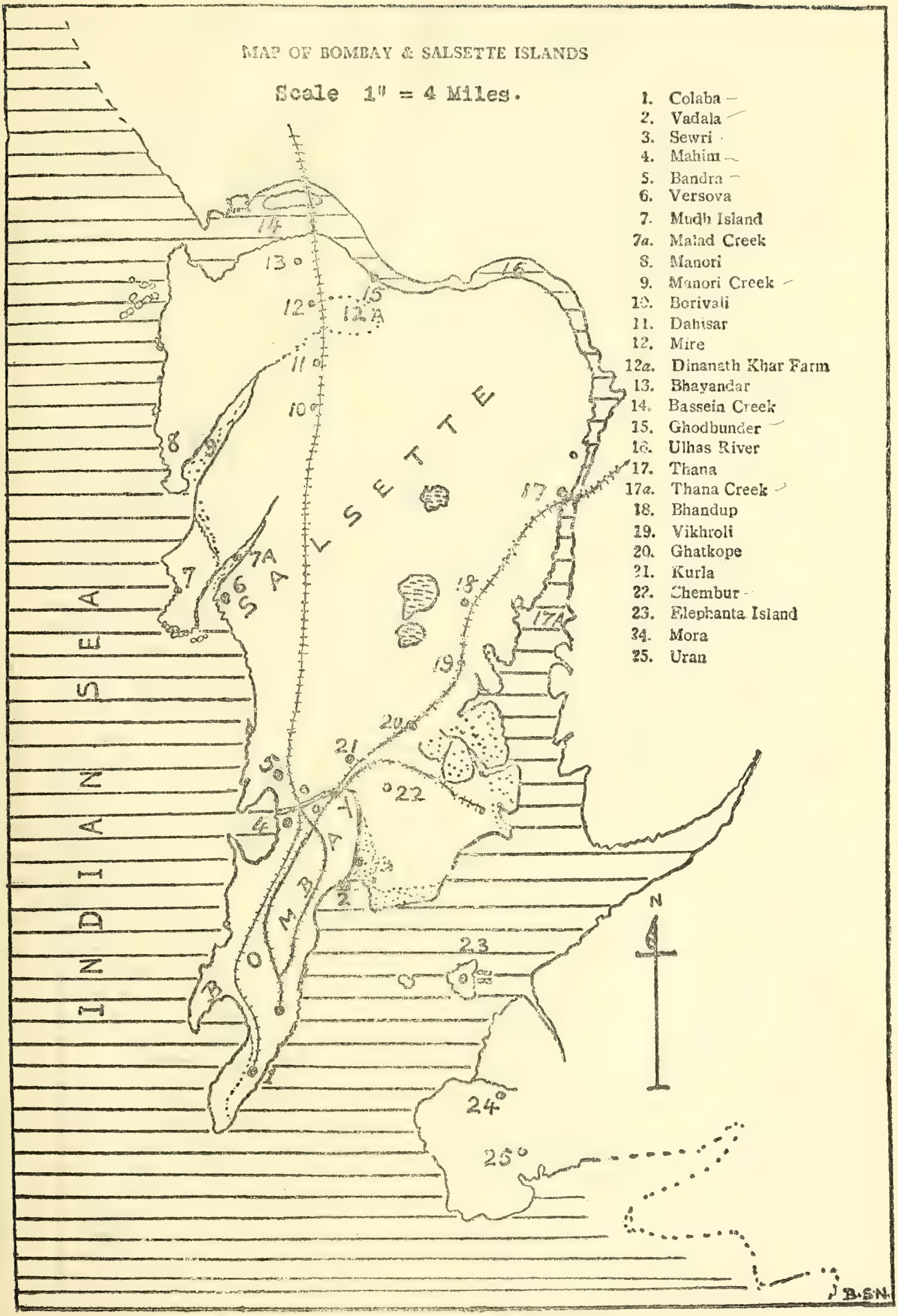
## 3. DISTRIBUTION IN BOMBAY ISLAND

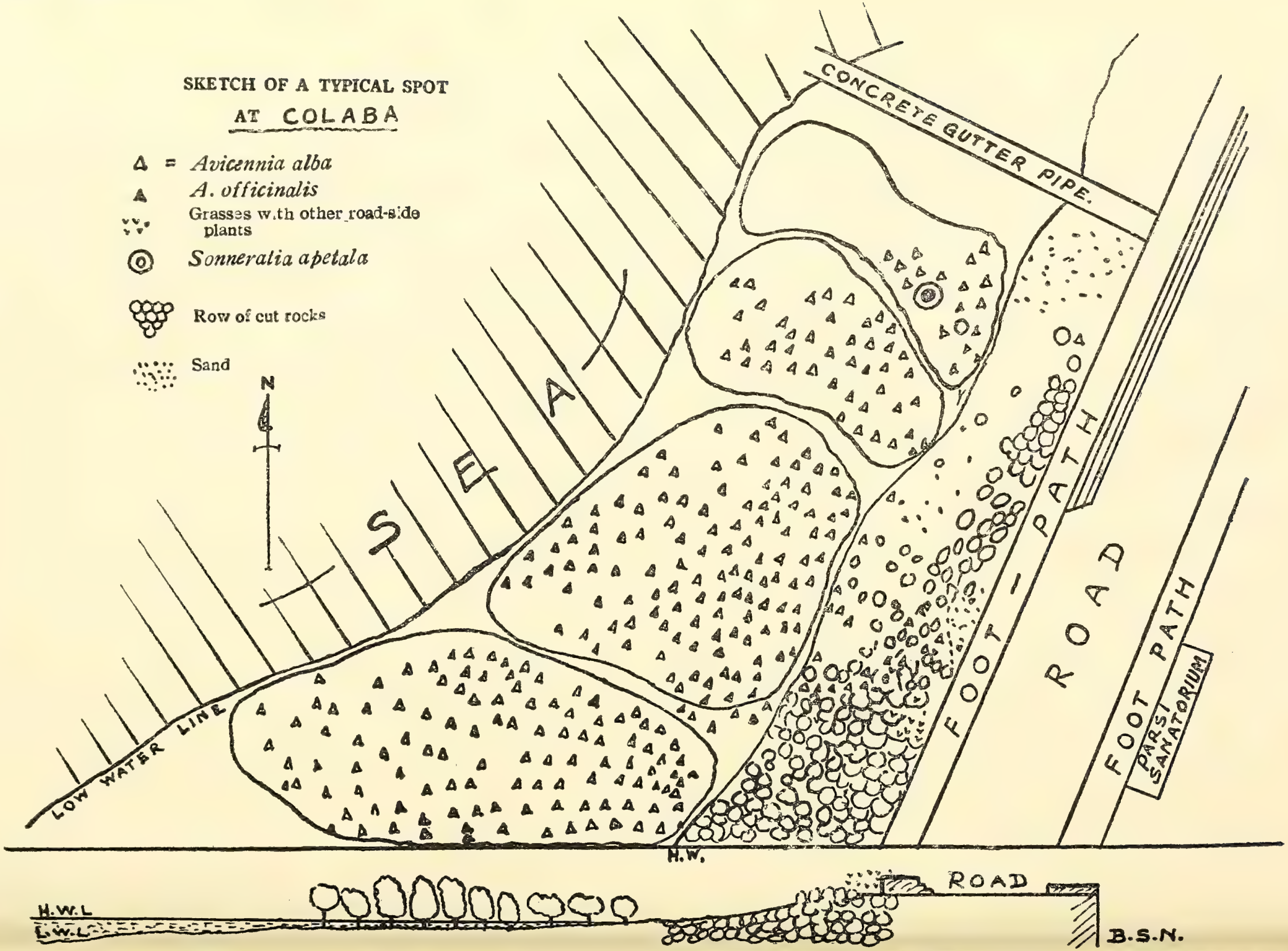
### Colaba

*Avicennia alba* Blume is found growing on the western side from the Colaba Parsi Sanatorium to the end of the rocks southwards (Plate II). The plants mainly occur as large bushes, though a few small trees are met with where human influence is not marked. On the south-west, towards the Colaba Barracks, a very few bushes are found. From the B.I. Barracks as one goes up as far as Sewri, the south-eastern coast is without vegetation as there are many docks all along it and the sea is deep. The Back Bay Reclamation coast on the west does not bear any vegetation; nor is any mangrove to be seen from Charni Road to Government House. Between Malabar Point and the Breach Candy Baths, the mangrove vegetation consists only of small and sparse bushes of *Avicennia alba*, as the coast is full of big rocks. This species is again found at Worli near Haji Ali's Tomb and at New Worli. From Worli to Mahim there is a sandy beach.

### Mahim

From Mahim fort as one enters the Mahim creek towards the east, *Avicennia alba* is found in plenty along the coast, together with small bushes of *A. officinalis*. Here also near the railway lines, there are a few clumps of *Acanthus ilicifolius* and two or three of *Ceriops candolleana*, *Bruguiera caryophylloides* and *Sonneratia apetala*. Along the railway lines from Mahim towards Bandra on the left, *Clerodendrum inerme* is found on the edge of the creek, and on drier soil patches of *Sesuvium portulacastrum* with *Suaeda fruticosa*. The grasses that are found on still drier soils are *Sporobolus glaucifolius*, *Fimbristylis polytrichoides*, and *Aeluropus villosus*. Except for the presence of a couple of *Rhizophora mucronata*, the vegetation on the right side of the line is the same as that on the left (Plate III).


MAP OF BOMBAY & SALSETTE ISLANDS
Scale 1" = 4 Miles.
1. Colaba
2. Vadala
3. Sewri
4. Mahim
5. Bandra
6. Versova
7. Mudh Island
7a. Malad Creek
8. Manori
9. Manori Creek
10. Borivali
11. Dahisar
12. Mire
12a. Dinanath Khar Farm
13. Bhayandar
14. Bassein Creek
15. Ghodbunder
16. Ulhas River
17. Thana
17a. Thana Creek
18. Bhandup
19. Vikhroli
20. Ghatkope
21. Kurla
22. Chembur
23. Elephanta Island
24. Mora
25. Uran
INDIAN SEA
SALSETTE
BOMBAY
N
B.S.N.



SKETCH OF A TYPICAL SPOT AT COLABA

Δ = *Avicennia alba*
▲ *A. officinalis*
Grasses with other road-side plants
◎ *Sonneratia apetala*
Row of cut rocks
Sand
N
CONCRETE GUTTER PIPE.
SEA
LOW WATER LINE
FOOT - PATH
ROAD
FOOT PATH
PARSI SANATORIUM
H.W.
ROAD
H.W.L
L.W.L
B.S.N.

From Mahim to Sion following Dharavi Road along the shore where there is a dry soil, patches of *Aeluropus villosus* are found with *Clerodendrum inerme* on the left hedge. Near the Municipal drainage may be seen *Avicennia alba* and *A. officinalis* with little patches of *Aeluropus villosus*, and further near the roadside, patches of *Acanthus ilicifolius*. Small bushes of *Avicennia alba* are found up to Sion railway station. West of Sion railway station and near the creek on the two sides of Poona-Agra Road, *Acanthus ilicifolius* is found profusely with little patches of *Avicennia alba*. While further down towards Kurla, on the opposite bank of the Mahim river, the picture is reversed, *Avicennia alba* becoming more and more prominent up to Kurla railway station, where it grows abundantly with a few bushes of *Acanthus ilicifolius*.

## Vadala

The harbour is very different from the areas so far investigated in that the vegetation is a constant mixture of *Avicennia alba*, *Acanthus ilicifolius*, *Sesuvium portulacastrum*, *Salvadora persica*, *Clerodendrum inerme* and grass with *Salicornia brachiata* invariably present at the edges near the bund.

Towards the land in the salt-pan area where the creek water comes in, *Sesuvium portulacastrum* and *Suaeda fruticosa* grow on the drier land, while *Aeluropus villosus* is confined to the banks of the water inlet.

From Sewri to Trombay via Vadala, *Avicennia alba* grows abundantly along the shore. Here again on the drier soils near the Port Trust railway lines, *Aeluropus villosus* forms patches together with *Sesuvium portulacastrum* and a little *Suaeda fruticosa* (Plate IV).

Near about Sewri Koliwada, *Avicennia alba* grows profusely in bushes. From the Bulk Oil Installation along the Vadala shore, *Avicennia alba* grows thickly in bushes. Here, on drier soil, *Aeluropus villosus* grows widely. Practically the whole of Vadala shore is full of *Avicennia alba*. Near the Port Trust railway bridge over the creek *Avicennia alba* is found abundantly on both the sides, with little patches of *Suaeda fruticosa* and *Clerodendrum inerme* in bushes on the banks as well as *Sesuvium portulacastrum*. On the east of the bridge, *Avicennia alba* is in full form as small trees. *Salvadora persica* is found near the bridge.

Along the oil pipe line towards the pier on the right eastern side *Avicennia alba* covers practically the whole area. Mainly trees are found and they are at a distance of 15 to 20 feet apart. Lots of bushes are cut for fuel on the right side of the pipe line. Here also on the drier ground *Aeluropus villosus* is found together with *Sesuvium portulacastrum* and *Acanthus ilicifolius* further down towards the pier. Some *Salvadora persica* trees are found on the left of the pier line.

Towards the Customs Tower near the mouth of the creek, first a big patch of *Aeluropus villosus* is found on drier soil; then further from the pipe line near the sea, small bushes of *Avicennia alba* are seen which further down are replaced by trees. Beyond the Customs pier, going south-west, inside the mouth of the creek, *Avicennia alba*, *Aeluropus villosus*, and *Acanthus ilicifolius* are found together on the right. On the left, near the pipe line, *Avicennia* is found as far as Pir Pau's Tomb.

From Vadala towards Sewri along the coast on the drier soil, *Aeluropus villosus* grows in big patches, and near the shore *Avicennia alba* completely occupies the area. Nearer and in Sewri docks in Koliwada, there are *Avicennia alba* trees growing on the muddy ground. Also at Sewri Bunder towards the north bank, *Avicennia* trees abound, but only small bushes are found where human influence is felt near the Dry-fish Wharf.

The western coast of Trombay Island is practically without mangrove vegetation. As one goes up from the pipe line northwards Kurla via Anik, Vasi and Maraoli, salt-pans are evident everywhere. As one reaches near Kurla from the light tramway line (now discontinued), one comes across little bushes of *Avicennia* on the right.

*Avicennia alba* is also found south of Chembur along the railway lines near the salt-pan areas, and on the eastern side of Trombay hill near the shore. (Recently, due to the installation of the petroleum refineries, much of this vegetation is destroyed.)

## 4. DISTRIBUTION IN THE SALSETTE ISLAND

### Bandra

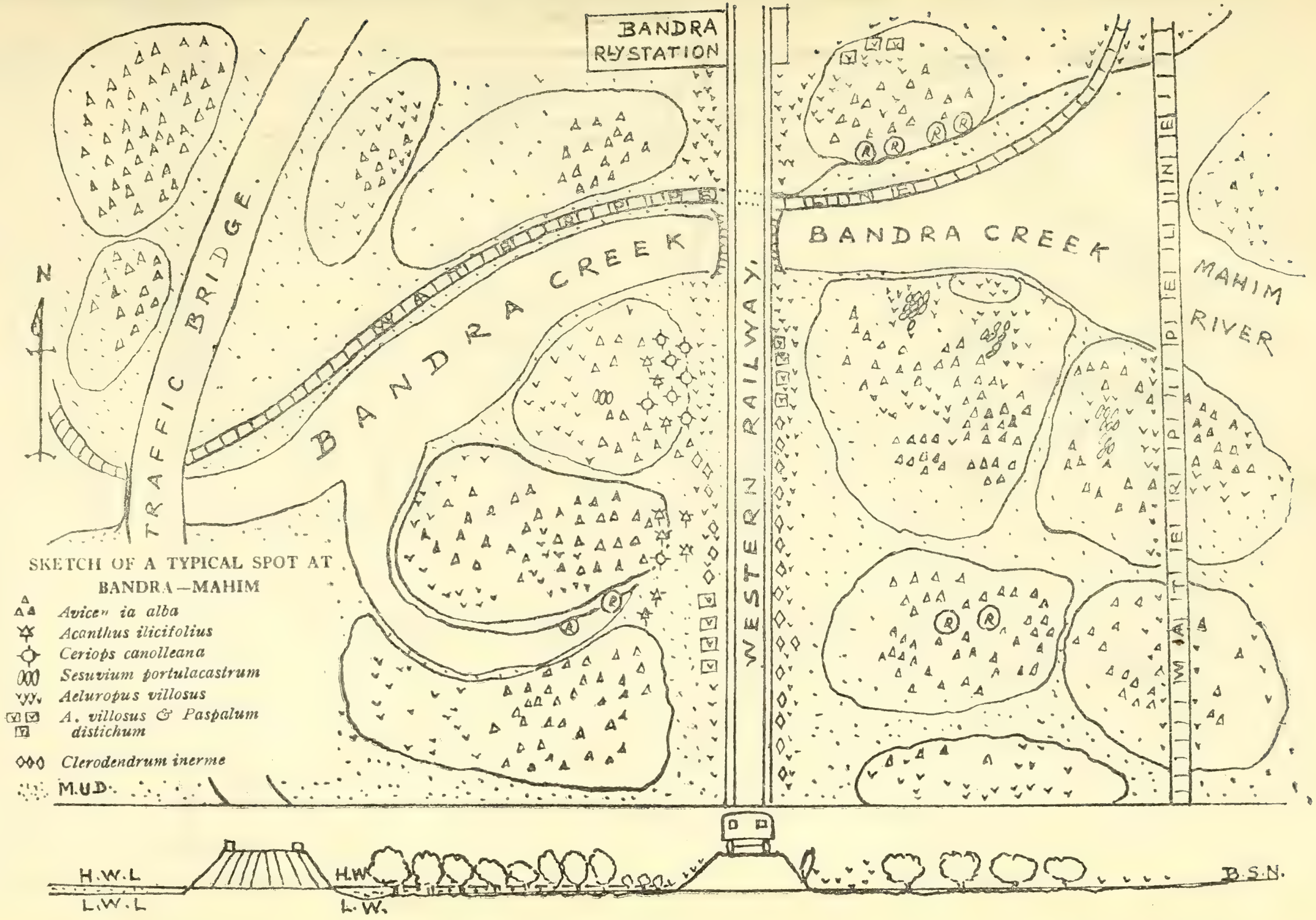
From Kurla to Bandra along the bank of Mahim river, mangrove vegetation is poor both in quality and quantity. There are patchy bushes of *Avicennia alba* near the high water line right up to Bandra railway station, and thicker bushes on the other side of the station near the water pipe line and the slaughter house up to the vehicular traffic bridge (causeway). Along the railway lines near Bandra station eastwards, *Avicennia alba* is also present. This vegetation of *Avicennia* is inter-mixed with bushes of *Clerodendrum inerme* on the bund and patches of *Aeluropus villosus* on drier soil. *Sesuvium portulacastrum* also occurs in patches. Besides there are a number of Gramineae and Cyperaceae, such as *Sporobolus glaucifolius*, *S. pallidus*, *S. orientalis*, *Panicum glabrum*, *Faspalum distichum*, *Fimbristylis ferruginea*, *F. polytrichoides*, *Setaria glauca*, *Cyperus rotundus*, *C. compressus*, growing on the drier soil in patches, especially near the railway lines.

From the causeway along the shore there are a few *Avicennia* bushes in the bay, but towards Bandra Point the shore is rocky. From Bandra Point right up to Danda, on account of the rocky shore no mangrove vegetation is found. Near Danda on the shore, and in the creek there are a few bushes of *Avicennia*. From Danda to Versova (Vesavé) the coast is of a sandy nature and therefore no mangrove vegetation is to be seen there.

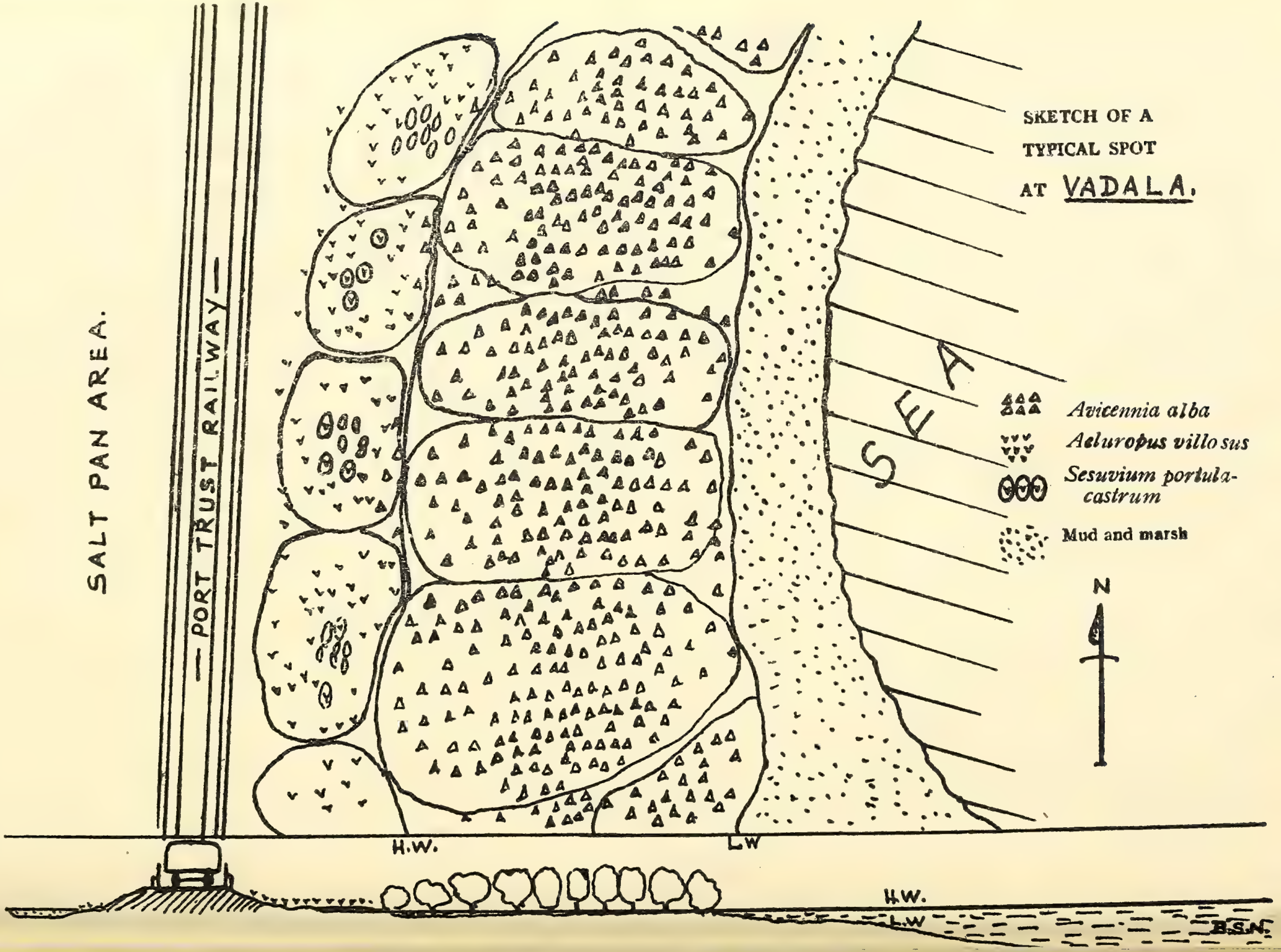
### Versova

Versova is at the mouth of the Malad Creek, which opens with a large tract of mud and marsh covering about 4 sq. miles on the right. The area contains a few scattered bushes of *Avicennia*, with patches of *Aeluropus villosus* and *Sporobolus* species on drier soil.

Opposite Versova there is an island called Mudh, on the eastern coast of which there is mangrove vegetation consisting mainly of *Avicennia* trees. The southern coast is full of rocks and the western coast is covered or interrupted with rocks up to Erangal. From Erangal right up to Marve and still further, there is a fine sandy beach which one meets as one enters the Marvé Creek.


BANDRA RLY STATION
TRAFFIC BRIDGE
BANDRA CREEK
BANDRA CREEK
WESTERN RAILWAY
WATER PIPELINE
MAHIM RIVER
N
Avicennia alba
Acanthus ilicifolius
Ceriops canolleana
Sesuvium portulacastrum
Aeluropus villosus
A. villosus & Paspalum distichum
Clerodendrum inerme
M.U.D.
H.W.L
L.W.L
H.W.
L.W.
B.S.N.

SKETCH OF A TYPICAL SPOT AT BANDRA—MAHIM



SKETCH OF A TYPICAL SPOT AT VADALA.

SALT PAN AREA.
— PORT TRUST RAILWAY —
SEA
Avicennia alba
Aeluropus villosus
Sesuvium portulacastrum
Mud and marsh
N
H.W.
L.W.
H.W.
L.W.
B.S.N.

### Manori Creek

On the right side of the bank and near the main road from Malad, there are a few *Avicennia* trees but, beyond that, the whole place is practically devoid of any mangrove vegetation as far as Shimpaoli, where *Avicennia* reappears and spots the area as far as Mandapeshwar and still further along the shore of Manori Creek. Similarly, on the left bank of Manori Creek (while entering from Manori) and near Manori village, mangrove vegetation can be noticed with *Avicennia* and also grass like *Sporobolus glaucifolius*, *Aeluropus villosus*, etc. on the drier patches of soil. The mangrove bushes are scattered as far as the salt-pan area up to Mira Road railway station, where again the grasses are to be found. Going further in the Manori Creek near Mira Road station beyond the railway lines, *Avicennia alba* grows profusely together with *Ceriops candolleana* and *Acanthus ilicifolius* in small groups. On the bund banks towards the south-west, *Salvadora persica* is also found, and *Aeluropus villosus* and *Suaeda fruticosa* are to be seen on the drier land. *Clerodendrum inerme* is in evidence in the bund (hedge). In the Dinanath Khar Farm Land, as well as just near Mira Road station, these mangrove and marshy plants can also be marked.

Then again when one goes northwards from Manori along the coast there is hardly any mangrove on the western shore, as the whole coast is sandy, interrupted with rows of rocks as far as the light-house. On entering Bassein Creek one comes across *Avicennia* and *Rhizophora*, mainly between the low water line and high water line, as far as Bassein bridge. From Bassein bridge as far as Ghodbunder no mangrove vegetation is seen.

### Ghodbunder

Near Ghodbunder there is a profusion of *Rhizophora mucronata*, *Avicennia alba*, *A. officinalis* and *Sonneratia apetala*. There is an abundance of *Rhizophora* and *Avicennia* near the Ghodbunder Temple (Plate V). Still further beyond the Temple and the Tank, *Rhizophora mucronata*, *Avicennia alba*, *Bruguiera gymnorhiza* and *Ceriops candolleana* grow near the water, while *Acanthus ilicifolius*, *Salvadora persica*, *S. oleoides*, *Salicornia brachiata*, *Aegiceras majus* and *Aeluropus villosus* are found near the land which is comparatively dry. It is to be noted that *Avicennia* grows abundantly in spite of being browsed by animals, but near the land the plant occurs in stunted bushes. The same mangrove vegetation occurs up the Ullhas River up to Gaimukh Bunder, and at the mouth of Kamdevi River there is a big tract of marsh land, which consists of *Avicennia* and *Rhizophora* on the muddy ground and *Acanthus* and *Aeluropus* on drier soil. Further south, mangrove is seen from a village Bagvilpada to a mile further on the coast, where vegetation ceases as far as Kasheli bridge.

### Thana Creek

As one enters Thana Creek from Kasheli bridge, *Salvadora*, *Sesuvium*, *Acanthus*, *Sporobolus* and *Aeluropus* can be found especially on the left, that is on the opposite bank of the creek. This continues as far as Thana Traffic bridge. Between the latter and Thana railway bridge there are small islands on which *Avicennia*, *Acanthus* and *Sesuvium* are found, From the railway bridge as one goes south, the vegetation on the island consists mainly of *Avicennia alba*, *Acanthus ilicifolius* on the muddy soil and the grasses like *Sporobolus glaucifolius* and *Aeluropus villosus* on drier soil. A few furlongs from the railway bridge towards the south there is a large marshy tract with *Avicennia alba*, *Acanthus ilicifolius* and grasses in heaps on the drier soil, such as *Aeluropus villosus*, *Sporobolus glaucifolius.* The marsh tract extends as far as Chembur, covering Kopri, Naughar, Nanapada, Bhandup, Kanjur, Vikhroli, and Ghatkoper. The vegetation chiefly consists of *Avicennia alba* with occasional bushes of *Acanthus ilicifolius* and large patches of grasses and cyperaceae such as *Aeluropus villosus*, *Sporobolus glaucifolius*, *Fimbristylis* species and *cyperus* species. Here it is to be noted that the vegetation does not extend to the low water line. This marshy tract stretches about 2 miles towards the east near the railway lines from Bhandup to Ghatkoper. At Ghatkoper the tract still goes further a mile, reaching about 3 miles east from the railway station.

### Ghatkoper-Kurla

Ghatkoper, Kurla and Chembur form a triangle in which no mangrove vegetation is found, except a few bushes of *Avicennia officinalis* and *A. alba* that are found along the main road from Ghatkoper to Chembur. Otherwise this triangle is full of grasses such as *Aeluropus villosus*, *Sporobolus glaucifolius*, *Fimbristylis* species, *Paspalum distichum*, *P. vaginatum*, *Cyperus compressus*, *C. rotundus.*

### Chembur

From Chembur to Mandalé, the mangrove vegetation is of *Avicennia alba*, a few *A. officinalis* and lots of grasses as well.

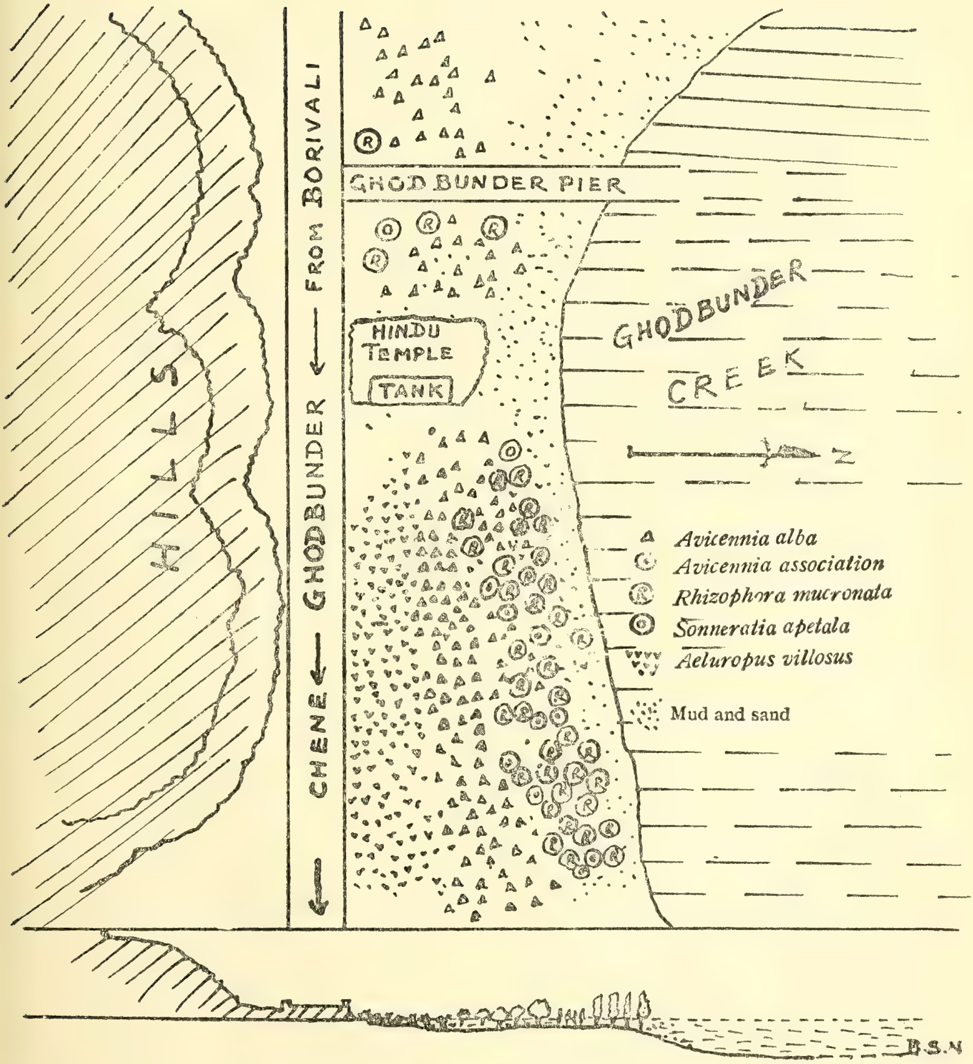
From Mandalé to Trombay the condition of the vegetation remains the same. At Trombay the mangrove becomes more prominent towards the south-east near the beacon. From the beacon towards the coast as far as Pir Pau's Tomb it consists mainly of *Avicennia officinalis.* The grasses are few except near Pir Pau's Tomb, where *Aeluropus villosus* and *Sporobolus glaucifolius* are seen near the shore. It is to be noted here also that whatever vegetation is found from Trombay to Pir Pau's Tomb lies only between the high water and low water lines. From Pir Pau's Tomb to the Oil Pipe line, it has been already seen that the mangrove vegetation consists of *Avicennia alba* only, with little bushes of *Acanthus ilicifolius.*

## 5. THE DISTRIBUTION OF VEGETATION SHOWING CHARACTERS

The distribution of the mangrove vegetation in the Bombay and Salsette Islands shows the following characters :

(1) The *Clerodendrum inerme* is always confined to bunds that surround the hedges of the area i.e., it is found on the highest places where the sea-water does not reach and influence the salt content of the soil; therefore, from this point of view this plant might be considered as the poorest of the halophytes, though it may be pointed out that it develops halophytic characters when it is grown in soils rich in sodium-chloride. This plant is now extensively used as garden hedge-plant in

SKETCH OF A TYPICAL SPOT
AT GHOD-BUNDER.


HILLS
FROM BORIVALI
GHODBUNDER
CHENE
GHODBUNDER PIER
HINDU TEMPLE
TANK
GHODBUNDER CREEK
N
Avicennia alba
Avicennia association
Rhizophora mucronata
Sonneratia apetala
Aeluropus villosus
Mud and sand
B.S.N.

Bombay and its suburbs, where the soil contains a normal amount of sodium-chloride.

(2) Along with *Clerodendrum inerme*, on the dry soil, grasses of the types *Fimbristylis polytricoides*, *F. ferruginea*, *Sporobolus glaucifolius*, *S. pallidius*, *S. orientalis*, *Panicum glabrum*, *Paspalum disticum*, *Cyperus compressus*, *C. rotundus* are found.

(3) The next plants in succession, which grow on a soil moister and slightly richer in sodium-chloride than the soil of *Clerodendrum inerme*, are *Aeluropus villosus*, *Sesuvium portulacastrum* and *Suaeda fruticosa*.

(4) In the next of the soil conditions, the following plants are found: *Aeluropus villosus* and *Sesuvium portulacastrum*.

(5) The next stage is entirely covered by *Aeluropus villosus*.

(6) The final stage is formed by the mangroves consisting of the following species: *Avicennia alba*, *A. officinalis*, *Rhizophora mucronata*, *Ceriops candolleana*, *Sonneratia acida*, and *Acanthus ilicifolius*. Amongst these plants (*a*) *Acanthus ilicifolius* occupies the farthest position from the sea; (*b*) then comes the group of plants consisting of the following: *Avicennia alba*, *A. officinalis*, *Ceriops candolleana* and *Sonneratia acida*; and (*c*) finally comes *Rhizophora mucronata* which covers the soil nearest the sea-water and therefore probably the soil richest in sodium-chloride content.

## 6. COMPARATIVE DISTRIBUTION OF VEGETATION IN OTHER PLACES

The following is an alphabetical list of halophytic plants of Bombay and Salsette Islands, Sunderbans, Malay Peninsula and South Africa, with their geographical distribution. It may be mentioned that the names of the plants have been brought up to date according to the International Rules of Botanical Nomenclature.

TABLE 1

(*Note*: Presence = plus sign; Absence = minus sign)

| Names of Plants | Bombay and Salsette Islands | Sunder-bans | Malay Peninsula | South Africa | Geographical Distribution |
|---|---|---|---|---|---|
| 1. *Acanthus ilicifolius* Linn. | + | + | + | + | Tropical Asia, Australia. |
| 2. *A. ebracteatus* Vahl. ... | — | — | + | — | Tropical Asia. |
| 3. *A. volubilis* Wall. ... | — | + | — | — | India. |
| 4. *Acrostichum aureum* Linn. | — | — | + | + | Tropical Coasts. |
| 5. *Aegiceras majus* Gaertn. ... | + | + | + | + | Old World Tropics. |
| 6. *Arthrocnemum indicum* Moq. | + | + | — | + | India, Tropical Africa. |
| 7. *Atriplex stocksii* Boiss. ... | + | — | — | — | India, (Coasts of Saurashtra). |
| 8. *Avicennia alba* Blume* ... | + | + | + | — | ... |
| 9. *A. intermedia* Griff.* ... | — | — | + | — | ... |
| 10. *A. lanata* Ridley* ... | — | — | + | — | Malaya Peninsula. |
| 11. *A. marina* Forsk.* ... | — | — | — | + | ... |
| 12. *A. officinalis* Linn. ... | + | + | + | — | Tropical shores. |

TABLE 1—(*Continued*)

| Names of Plants | Bombay and Salsette Islands | Sunder-bans | Malay Peninsula | South Africa | Geographical Distribution |
|---|---|---|---|---|---|
| 13. *A. nitida* (alter) Sesse & Moc. | — | — | — | + | Tropical America, Tropical Africa. |
| 14. *Brownlowia lanceolata* Benth. | — | — | + | — | India, Burma. |
| 15. *B. reidelli* Hemal ... | — | — | + | — | Spicy Islands. |
| 16. *Bruguiera caryophyllaeoides* Blume | — | — | + | — | India, Malaya. |
| 17. *B. eriopetala* Wight & Arn. | — | — | + | — | Tropical Asia. |
| 18. *B. gymnorhiza* Lam. ... | + | + | + | + | Old World Tropics. |
| 19. *B. parviflora* Wight & Arn. | — | + | + | — | India, Malaya. |
| 20. *Carapa moluccensis* Lam. | — | — | + | — | Old World Tropics. |
| 21. *Cerbera odellum* Gaertn. ... | — | — | + | — | India, Malaya. |
| 22. *Ceriops candolleana* Arn. ... | + | + | + | + | Tropics. |
| 23. *C. roxburghiana* Arn. ... | — | + | — | — | Tropics. |
| 24. *Clerodendrum inerme* Gaertn. | + | + | — | — | India. |
| 25. *C. nereifolium* Wall. ... | — | + | — | — | Malaya. |
| 26. *C. siphonanthus* (R. Br. in Ait. Hort. Kew). | — | + | — | — | India, Malaya. |
| 27. *Cressa cretica* Linn. ... | + | — | + | — | Cosmop. Tropics. |
| 28. *Cycas rumphii* Miq. ... | — | — | + | — | Malaya, Australia. |
| 29. *Daemonorops leptopus* Mart. | — | — | + | — | Malaya. |
| 30. *Derris uliginosa* Benth. ... | — | — | — | — | Old World Tropics. |
| 31. *Eugenia corymbosa* Berg. ... | + | — | — | — | Peru. |
| 32. *E. fruticosa* Roxb. ... | — | + | + | + | Burma. |
| 33. *Excoecaria agallocha* Linn. | + | + | | | Tropical Asia, Malaya, Pacific Islands. |
| 34. *Heritiera littoralis* (Dryand. in Ait. Hort. Kew). | — | — | + | — | Old World Tropics. |
| 35. *Hibiscus tiliaceus* Linn. ... | — | — | + | — | Both Tropics. |
| 36. *Intsia* (= *Afzelia*) *retusa* Kurz. | — | — | + | — | Malacca. |
| 37. *Kandelia Rheedii* Wight & Arn. | + | + | + | — | India, Malaya. |
| 38. *Kochia indica* Wight ... | + | — | — | — | India. |
| 39. *Lumnitzera coccinea* Wight & Arn. | — | — | + | — | Tropical Asia and Australia. |
| 40. *L. racemosa* Willd. ... | + | + | + | + | Old World Tropics. |
| 41. *Nipa fruticans* Thunb. ... | — | + | + | — | East of Ganges, Malaya. |
| 42. *Onocosperma filamentosum* Blume | — | — | + | — | Malaya. |
| 43. *Pluchea indica* Less. ... | — | — | + | — | Tropical Asia and Australia. |
| 44. *Podocarpus neriifolia* D. Don. | — | — | + | — | Himalayas. |
| 45. *Rhizophora mangle* Linn. ... | — | — | — | + | Littoral Tropics. |
| 46. *R. mucronata* Lam. ... | + | + | + | + | Old World Tropics. |
| 47. *Salicornia brachiata* Roxb. | + | + | — | — | India. |
| 48. *S. herbacea* Linn. ... | — | — | — | + | Europe. |

TABLE 1—(*Continued*)

| Name of Plants | Bombay and Salsette Islands | Sunder-bans | Malay Peninsula | South Africa | Geographical Distribution |
|---|---|---|---|---|---|
| 49. *Salsola foetida* Delile ... | + | — | — | — | Tropical Africa, Arabia, India. |
| 50. *S. kali* Linn. ... | + | — | — | — | North region and Temperate Australia. |
| 51. *Salvadora persica* Linn. ... | + | — | — | + | The Orient, India, North Africa. |
| 52. *Scyphiphora hydrophyllacea* Gaertn. | — | — | + | — | Islands of Spices. |
| 53. *Sesuvium portulacastrum* Linn. | + | + | — | + | Tropics. |
| 54. *Sonneratia acida* Linn. ... | + | + | — | + | India, Malaya. |
| 55. *S. alba* Sm. ... | — | — | + | + | Old World Tropics (India, Burma, Andamans). |
| 56. *S. apetala* (Buch.-Ham. in Syme Emb. Ava.) | + | + | — | + | India, Burma. |
| 57. *S. griffithii* Kurz. ... | — | — | + | — | Burma. |
| 58. *Suaeda fruticosa* Forsk. ... | + | — | — | — | North Temperate Regions. |
| 59. *S. linearis* Moq. ... | — | — | — | + | North America, Cuba. |
| 60. *S. maritima* Dum. ... | + | + | — | — | North Temperate Regions, Australia. |
| 61. *S monoica* Forsk. ... | + | — | — | + | North Africa, West Asia, India. |
| 62. *S. nudiflora* Moq. ... | + | — | — | — | India. |
| 63. *Tamarix gallica* Linn. ... | + | + | + | + | India, Burma, Ceylon, Africa, Europe, Siberia, China, Japan. |
| 64. *Thespesia populnea* Corr. ... | + | — | — | — | India. |

* According to Index Kewensis all the 4 species of *Avicennia* mentioned here and marked with asterisk are one and the same, that is *Avicennia officinalis* Linn.

### TABLE 2

Alphabetical list of Gramineae and Cyperaceae found in marshy places near Bombay and Salsette Islands and Sunderbans, and their geographical distribution.

| Names | Bombay and Salsette Islands | Sunderbans, Bengal | Geographical Distribution |
|---|---|---|---|
| GRAMINEAE | | | |
| 1. *Aeluropus villosus* Trin. ... | + | — | North Africa, Greece. |
| 2. *Panicum glabrum* Gaud. ... | + | — | North temperate and Tropical Regions. |
| 3. *Paspalum distichum* Linn. | + | — | Tropics and Subtropics. |
| 4. *P. scrobiculatum* Linn. ... | — | + | Old World Tropics. |
| 5. *Setaria glauca* Beauv. ... | + | + | Europe, Temperate Asia. |
| 6. *S. verticillata* Beauv. ... | — | + | Cosmop. (In all parts of the world). |
| 7. *Sporobolus glaucifolius* Hochst. | + | — | Punjab, Sind, Tropical Africa. |
| 8. *S. orientalis* Kunth. ... | + | — | India, Punjab, W. Peninsula, Ceylon. |
| 9. *S. pallidus* Boiss. ... | + | — | Punjab, Waziristan, Rajputana Desert, Afghanistan, Baluchistan, Arabia. |
| 10. *S. virginicus* Kunth. ... | — | + | India, Ceylon, Africa, America, Australia, Tropics. |
| 11. *S. tremulus* Kunth. ... | — | + | India, Ceylon, Burma, Tonkin, Cambodia. |
| CYPERACEAE | | | |
| 12. *Cyperus compressus* Linn.... | + | — | All parts of the world Tropics. |
| 13. *C. exaltatus* Retz. ... | — | + | Tropical Asia and Australia. |
| 14. *C. inundatus* Roxb. ... | — | + | India, China. |
| 15. *C. malaccensis* Lam. ... | — | + | Tropical Asia. |
| 16. *C. rotundus* Linn. ... | + | — | All parts of the world. |
| 17. *C. scariosus* R. Br. ... | — | + | India, Australia. |
| 18. *C. tegetiformis* Roxb. ... | — | + | Tropical Asia. |
| 19. *Fimbristylis ferruginea* Vahl. | + | + | Both Tropics. |
| 20. *F. monostachya* Hassk. ... | — | + | Tropics of both worlds. |
| 21. *F. polytrichoides* R. Br. ... | + | + | Tropics of old world. |
| 22. *F. subbispicata* Nees. ... | — | + | Tropical Asia. |
| 23. *Scirpus articulatus* Linn.... | — | + | Africa, India, Australia. |
| 24. *S. grossus* Linn. ... | — | + | India, Malaya. |
| 25. *S. littoralis* Shrad. ... | — | + | Europe, Asia, Egypt. |
| 26. *S. triqueter* Linn. ... | — | + | Europe, Australia. |

## 7. CONCLUSIONS

(1) In Bombay and Salsette Islands six stages of different halophytic plants can be marked according to (*a*) the extent of the nearness of the plant to sea, and (*b*) consequent richness of sodium-chloride in the soil.

(2) On comparing the number of halophytes of Bombay and Salsette Islands with those of Sunderbans, Malay Peninsula and South Africa, it is found that Malay Peninsula is richest in the species having 35 out of 62 of the total list, i.e. 56·4%; Bombay and Salsette Islands stand second, i.e. they possess 27 species out of 62. The percentage comes to 43·5%. Sunderbans and South Africa have only 24 and 21 species respectively out of total 62, i.e., 38 7% and 33·9% respectively.

(3) Sunderbans seems to be richer than Bombay and Salsette Islands, in Gramineae and Cyperaceae that are found near the salt marsh places. The former has 17 out of total 26 species, i.e., 65·4%, while Bombay and Salsette Islands possess only 11 species out of total 26. This amounts to 42·3% of the species.

## 8. SUMMARY

It is noticed from this investigation that the distribution of the mangrove vegetation is chiefly composed of *Avicennia alba* which seems to be very prolific in growth and germination. Further in Bombay and Salsette Islands six stages of different halophytic plants can be marked according to (i) the extent of the nearness of the plant to sea, and (ii) consequent richness in sodium-chloride content of the soil. A comparison of the number of halophytes of Bombay and Salsette Islands is made with those of Sunderbans, Malay Peninsula and South Africa, and the percentage of different species is calculated.

## 9. ACKNOWLEDGEMENTS

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# KASHMIR—A FISHING HOLIDAY

BY

A. St. John Macdonald

(*With two plates*)

A holiday in Kashmir had always remained an unfulfilled ambition of mine for 20 years or more. In the earlier years when I was more robust for the privations of seeking mahseer in hitherto unfished waters, I always gave choice to such exploits, being also influenced by the crowds of army officers who booked beats well in advance and with whom one had to enter into competition. But now, with a softening with age, the desire to search out the unknown has passed and monster mahseer no longer an ambition. The fly and fly rod aided by the salubrious climate at 6,000 ft. are a relaxation more fitting to my mood and fancy.

It was in this state of mind that I decided on a two months' holiday in May and June of this year (1955) to the trout waters of the Bhringi and Lidder rivers in Kashmir, and I was not disappointed, indeed surprised at the excellent fishing available and the variety that went with it, from raging torrents under a canopy of conifers to wide-open valleys planted out with rice where almost every variety of fishing was in abundance: the big water of the main streams; the side channels overgrown with willows; the mill streams where the large cannibals lurked under a briar or cut-under bank; calm pools where dry fly could be used to good purpose; the big water in the lower beats where spinning is permitted and where good trout have been caught. Last but not least the trained and built-up streams, the Kokarnag and Kotus, presenting the angler with a series of pools and falls with weed beds and side vegetation, where only expert roll casting could get a fly to the hide-outs of the large trout—the reason why I failed.

A blank day was a rarity, even with log floating in full force, and two trout on at the same time by no means uncommon. This happened to me not once but a dozen times, crowned by my getting my largest fish 3 pounds 5 ounces on the tail fly, and one of 1 pound 13 ounces on the dropper.

The Bhringi was far the most popular, and most beats were fished on most days except for only short periods of a day or two by individual anglers. These, I was glad to see, were mostly army officers who are maintaining the old fidelity to past army traditions with growing enthusiasm. Those I saw in action worked hard with ill-chosen or hired rods and tackle, frequently using a stiff bamboo rod, twisted undressed line, all of which made it hard work, but they seemed to relish the experience—and they caught fish!

I myself did not use the spinning outfit much, as I found I got all the sport I needed on fly and caught all my larger trout in this way. But there is plenty of water and scope for the enthusiast with level-wind or threadline outfit.

For the seeker of big fish, he must concentrate on the mill streams unless he is fortunate enough to get permission to fish on one of the Trikker beats—formerly the Maharaja's reserved waters, now generally reserved for V.I.P's. But with plenty of fish from half a pound to two pounds and more, one can be well satisfied with a day's sport, especially since no beat is less than a mile and a half, and some are as much as three miles long.

If one has caught game fish like mahseer, or even the sporting little *Barilius bola* in trout fashion—that is, with fly rod and fine tackle—it is difficult to enthuse over fishing out *Salmo ferio* or Brown Trout—a silly poor-fighting fish, and by habit poor compensation by comparison. The big trout takes up his abode, like a python, under the exposed roots of a tree or a cut-under bank, where food comes to him to gobble up; only very rarely does he rise to fly or chase a lure or spinner. Quite often they are found in a hole in a mill stream no larger than a billiard table, full of frogs, so that when they are hooked they give little or no sport. They are certainly not elegant to look upon; and poor by comparison with the young active fish for the table. To catch them one must deviate from the fine art of fly, lure, or spinner, and dangle a fly with a few feet of line out, under bushes, trees and rocks. But it is the angler's vanity, I suppose, that makes him yearn for size—a big one is something to talk about—and holding a record singles you out from others. Or perhaps is it just a sense of achievement?

I personally got all my enjoyment from casting a long line across to the other side under some bush or rock to draw out a hiding fish, and the Naubug in this respect provided the most delightful fishing. It was wide, shallow, slow and clear; you saw your fish, and tried to prevent him seeing you by long casts and fine tackle.

Most of the beats I fished were at 6,000 feet elevation or over. There were always plenty of friendly jackdaws, a cuckoo somewhere about, and on the slopes near cultivation chukor; but bird life was not in the same prolific abundance as found when fishing for mahseer in the foothills.

But I have digressed from my purpose, which is to give a note for the benefit of others on conditions prevailing at present, with suggestions on fishing in Kashmir today.

Let me assure all those interested in trout fishing in Kashmir that, contrary to common assumption, instead of deteriorating the fishing has actually improved and has passed pre-war standards, certainly in the Bhringi and Lidder Valleys.

From a study of the remarks in the Fishery Watchers' books it would appear that round about 1942 the fishing in the Upper Bhringi, Bidhar and Dyus was hardly worth a visit. This was also the case with the Lidder after the big landslide when most of the fish died from some toxic deposits brought down by the flood.

I fished in all 14 beats for 41 days, from the 2nd June to 17th July 1955, and caught in all 565 fish of which 186 were retained, weighing 185½ pounds. This total was made up as follows:

| | | |
|---|---|---|
| 3 pounds and above | ... | 2 |
| 2 to 3 pounds | ... | 12 |
| 1 to 2 pounds | ... | 77 |
| Below 1 pound | ... | 95 |
| | | 186 (all weighed to the nearest ounce, and no selection or keeping only large fish). |

My best fish was 3 pounds 5 ounces, and best day 6 fish weighing 13 pounds 12 ounces.

I have given tabulated details later on to show how the various beats fished, and weights and lengths of some of the larger fish with their locations.

BIG TROUT: In the 41 days I fished I saw only one trout of about 5 pounds that jumped my hook, and lost three in big water that ran down cascades where it was impossible to follow with most of the line out when they either broke the cast or slipped the hook. These I never saw and may have been larger mountain barbel.

Having set out briefly the results I had, I will, for the benefit of members, set out in detail conditions as I found them.

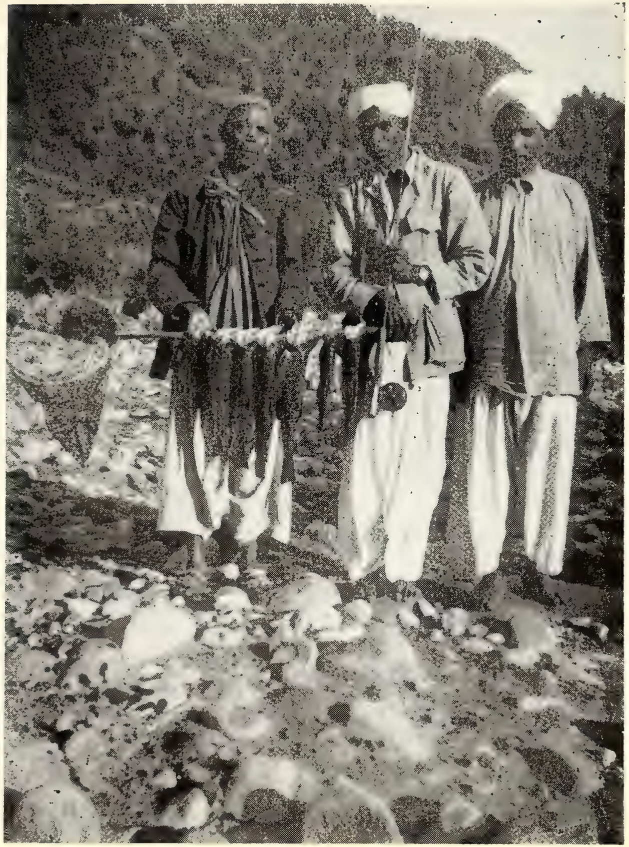
FORMALITIES AND TRAVEL: To enter Kashmir an Entry Permit is necessary. Foreigners from overseas can obtain them at the port of entry from the Tourist Bureau. Those resident or working in India must apply to the Ministry of Defence (Kashmir Permit Section), New Delhi, either direct or through the High Commissioner's Office, and for Indian Nationals the District Magistrate of the District of residence. Fourteen clear days' notice is required, but one is well advised to give a month.

Travel from Delhi is well organised and can be done in the lap of comfort by air or air-conditioned coach and fast train to Pathankote, where again there is the alternative of air or road. The distance by road to Srinagar is 267 miles and takes a day and a half by bus or motor coach. Cars can complete the journey in a day. By air it is only one hour's journey.

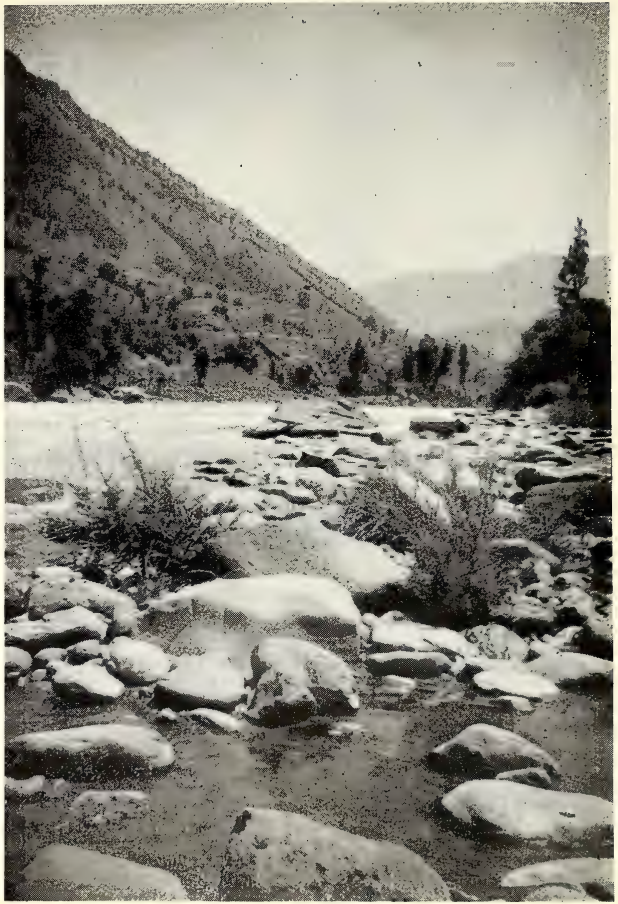
The approach from Lucknow via Jullunder is not well organised—in fact neglected—and train accommodation and timings are bad.

Srinagar is 5,200 ft. above sea level, but the road from Jammu rises to 7,000 and 9,000 ft. to cross the watersheds of the Ravi/Chenab and Chenab/Jhelum. So it is a good run and a full day's work for a car; speeding is not possible as there is very heavy traffic on the road. The road distances from the following places are as follows:

| | | |
|---|---|---|
| Bombay | ... | 1,441 miles |
| Delhi | ... | 564 ,, |
| Lucknow | ... | 877 ,, |
| Patna | ... | 1,196 ,, |
| Calcutta | ... | 1,492 ,, |

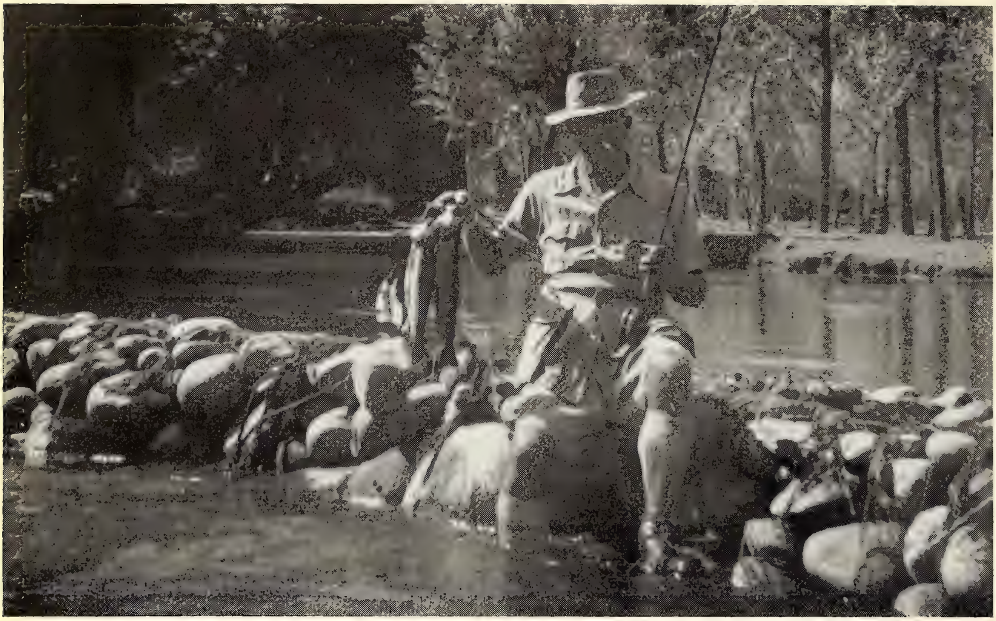


A nice bag of trout from the Liddar.

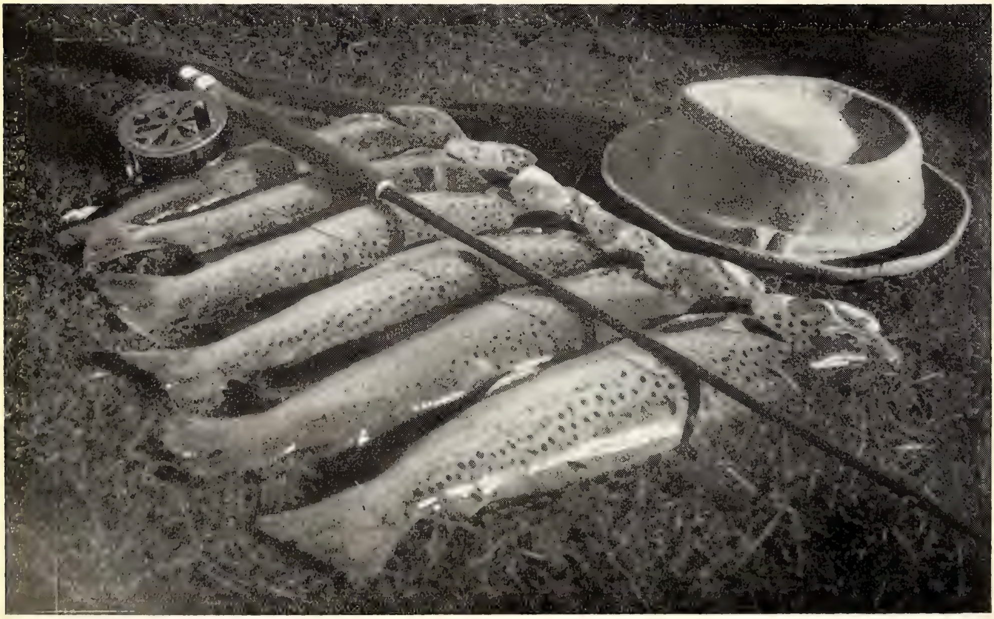


The Liddar Valley at Batkut.

*(Photos: A. St. J. Macdonald)*



The built-up Kotus showing one of the large pools formed by stone bunds at intervals throughout its course.



A nice bag of trout caught at Wahdan.

*(Photos: A. St. J. Macdonald)*

There are good dak bungalows and petrol pumps all along the route, but for your own comfort take gammexane or flit as both flies and bugs are bad at all halting places. On the way up we did not reach our resting place for the night until 1 a.m. owing to engine trouble, and the only accommodation available was a room in the bazar in a place glorying in the name of Royal Hotel. I had hardly got undressed when I saw some 17 bugs on and about my pillow. I spent the night seated on a step by the bus stand, for I would face any discomfort rather than be feasted on by 'pahari' bugs. If going by bus, as I did, it is advisable to take a sandwich lunch with you as meal halts are more for Indian tourists than for European, and the stand is often a long distance from the Rest House.

Suggestions: If going for a short holiday with limited kit, air travel is the quickest and most comfortable; if going, as I did, for a fishing and hiking holiday for 6 weeks, take your own car for choice, or send your heavy kit on ahead by servant and follow by air. There is an out-agency of the N.R.Y. in Srinagar should you care to risk booking your heavy luggage. Taxi fares are high in Srinagar: small cars 12 annas a mile, big cars Re. 1, station wagons Re. 1-4 and, as most of the beauty and fishing places are 50-60 miles away, your car soon covers its own expenses.

Accommodation: Do not allow any Agency to run your affairs, or they will most certainly rook you on a first visit. There is more than sufficient accommodation for Europeans in Srinagar in hotels and house-boats. Here is a list with charges.

| Hotels (European style) | Single room | Double room |
|---|---|---|
| Nedou's | Rs. 21 | Rs. 39 per day |
| Palace | ,, 22 | ,, 40 ,, |
| Park | ,, 11 | ,, 21 ,, |
| Boulevard | ,, 12 | ,, 22 ,, |
| Golf View | ,, 12 | ,, 22 ,, |

House Boats (5 room and fully furnished).

| | |
|---|---|
| Special Class ... | Rs. 800 per month. |
| 'A' Class ... | ,, 650 ,, |
| 'B' Class ... | ,, 500 ,, |

Note.—These can be obtained much cheaper on the spot by bargaining.

Licences and permits, bus fares and tour trips etc. can all be obtained through, and with the aid of the Government Tourist officials, always ready to help. There are also many brochures available which are full of information for the tourist.

Supplies and Provisions: Shops are all well stocked with all forms of stores at reasonable prices and nothing need be taken up from below. Scotch is Rs. 28 a bottle, English and Dutch beer Rs. 3-4 per bottle. Meat and fowls, milk and ghee are available at all the fishing beats, and good cooks and servants obtainable in Srinagar.

Subhana, the man I had, made excellent scones and bread in camp and cooked a good meal besides generally managing moves and porters. Fishing tackle is available from three or four good shops, but it is very expensive owing to the 80% duty charged on imports; but they have everything. Camp kit and tents can be hired at reasonable charges.

Fishing Beats and Charges: The rates for trout fishing are:—

Rs. 400 per rod for season (1st April to 30th Sept.).
,, 200 ,, ,, ,, half-season (3 months to run consecutively).
,, 30 ,, ,, ,, a week.
,, 7 ,, ,, ,, a day.

Changing of beats and dates are permitted provided one week's notice is given, and provided they are available. A weekly beat can be changed with a weekly, and a daily with a daily one. A beat is deemed to be available under the rules if found vacant 3 days before the commencement of the second period of fishing.

Season licence holders are entitled to fish all the trout waters open to fishing once in the season, provided they are available. A beat or beats may be allotted a second time provided they are available. Half Season licence holders are entitled to fish half the beats once in the season.

Weekly licence holders are not entitled to book weekly streams more than once, but a beat may be allotted a second time if available.

Daily licence holders will not be allotted during the season any daily beat more than twice in advance, but they may, at the discretion of the Director of Fisheries, be permitted a second spell. Kulgam streams and spring streams are allotted only once in the season to any one angler.

The size limit is 10 in. in most beats, and 12 in. in the built-up streams. A 10 in. fish weighs only 6 ounces and there are so many of these that they are a menace, and the limit could well be fixed at 12 in most of the beats I fished, while the quota is kept at 6 fish. This could also be fixed at 9 on the Bhringi and Lidder beats, *if anglers cooperate.*

Communications: Most of the beats can be reached by car over good roads, running for most part along the streams. Travellers' huts or rest houses are conveniently situated if you have your own car; otherwise a tent is more mobile and saves the forward planning of obtaining permission to use the bungalows which may have to be vacated at short notice for officials on tour.

Below is a summary with notes of results on the beats I fished.

There is charm and variety in fishing the various beats. The Upper Bhringi, and Bidhar its upper tributary break up into several channels, and the lightest tackle and small flies can be used in the side streams, with excellent dry fly water in places.

The Dyus is the upper Bidhar and is a beat of two mountain torrents running through heavy conifer forests in parklike surroundings, where one has literally to feel round and under boulders for fish, but what fish there are are of good size.

The Naubug, I found a delightful stream. It is slow flowing, wide and shallow, running through an open valley planted out with rice, where casts had to be long and tackle fine to keep out of sight of the fish, and in many respects was the nicest fishing I had in Kashmir. Here I 'caught the bird'! A sparrow took the fly on the backward cast.

The Middle and Lower Bhringi, with the Mahdan, Yenyer, and Batkut beats on the Lidder, is all big water, with four times the volume of water coming down the Lidder to that in the Bhringi. Most of the best fish are taken here by spinning.

The Kokarnag and Kotus are built-up streams and hold plenty of good trout. The Kokarnag (lower beat) is spoilt by running through villages for most of the way, though there are plenty of fish. I caught my two best fish in this stream, one in the midst of a mother's meeting by a bridge, and the other among washermen busy flogging clothes on stones!

The Kotus I found the most difficult to fish because of being planted out with willows to such an extent that there is not room to swing a cat in many of the best places, in fact I spent most of the day recovering my flies and cast from overhanging branches, but here too there are plenty of good trout.

THE BHRINGI is divided into 4 beats of approximately 2 to 3 miles each.

Upper (56)[1] All excellent water to suit all tastes; the main channel is fast heavy water, the side streams are small and wadeable, and full of fish but mostly small. There is plenty of water for two rods for a week.

Middle (54). I found it most disappointing, it is mainly flowing in one fast channel and had few fish. The Ahlan is also in this beat, and though it has a number of excellent pools, there are very few fish.

Lower (52). This is all big water in a series of large pools and runs, and some good fish of 6 and 7 pounds have been recorded. I only fished it for one day in July and did no good owing to a snow water flood.

Lowest (49). I did not fish this water, but it too holds good fish in April and May.

NAUBUG, BIDHAR, AND DYUS. These are all the upper tributaries of the Bhringi.

Naubug Lower (59). Is all excellent water traversing rice fields in an open valley, it is wide, slow and shallow, with some nice pools, and is the most fascinating fishing, where a long cast is necessary and water in places slow enough for casting up stream. There are plenty of fish and of a rich golden colour.

Naubug Middle (62). From the Larnu Bridge to a point 3 miles up the road to Guridramer and is similar to the lower, running in an open valley and holds plenty of fish. It leaves the road some distance on the right bank for the first two miles. A really delightful beat.

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[1] Miles from Srinagar.

Naubug Upper (66). This is about 5 miles in extent; the lower portion is through rice fields, but the valley closes in and the upper reaches are through fir forest and exquisite scenery, where it is a series of falls and pools and should be excellent in September. I found no fish high up, but they were plentiful in the frog area among the rice fields. This is all excellent water, above 6,000 ft. elevation.

Bidhar (58). This fast flowing and clear stream carries more water than the Naubug, and has more fish, and is very popular with anglers. It runs in a number of channels and has good water all the way and is near the road.

Dyus (60). Is an upper tributary of the Bidhar which is joined by the Mantar a slightly smaller stream. Both are mountain torrents falling fast from the delightful evergreen forests where giant firs keep the water in shade most of the day. It is not the form of fishing I fancy, searching with a short line round boulders and swirls for hiding trout, but the parklike surroundings more than compensate for these limitations, and the trout are large.

THE LIDDER VALLEY. This is a large river with four times the quantity of water in the Bhringi and flows down a valley 3 or 4 miles wide, up which is Phalgam a favourite holiday resort at 7,000 ft.

Batkut (54). The river in July looks more like a hold for 40-pound mahseer than for trout, difficult going and the whole volume of water runs down in one fast channel. I caught only one fish and only saw two others. It is reported to be better in September. There was in progress heavy timber floating which I fancy sent the trout to ground.

Yenyer (50). This is the next beat down the river and is better water as it breaks up into three channels and should be good fishing, but I did no good. I spent 18 hours flogging the water to catch 9 fish, 5 of which I returned. I was too late as the snow melt was at its peak. It is I believe good in the early Spring and Autumn.

Wahdan (50). This is the next beat down stream and the river opens up very considerably and about half the water is taken off by canals and irrigation channels and the fishing is really excellent when the water is not discoloured or swollen from melting snow. I found the fish here very strong and game, the best in fact I had struck anywhere.

Kotus (38). I was permitted by the kindness of Mr. Malik, the Director of Fisheries and warden in charge, to fish this stream for a day. The allowance is only 4 fish of 12 in. in a day, but it is a most interesting little stream built up and trained into a series of pools and falls through villages and rice fields overgrown for most part by willows. It needs expert casting, plenty of wading, and the utmost skill in dropping a fly under bushes, briars, and over weed beds and washed roots of trees.

I caught more willows than fish but enjoyed every moment of the experience. Big trout have been taken and many others are reported to be still in hiding, but they were too skilful for me.

Kokarnag (46). This small stream in the lower Bhringi valley is divided into two beats and like the Kotus is trained and built up but without the willows to hamper the use of a rod. The upper is in open rice country but the lower for most part is through villages, and though the fish are large and plentiful the environs do not appeal to the taste, as dhobi ghats, bathing places and mother's meetings are hardly conducive to trout fishing. I caught my largest fish under a bridge in the village with a dozen women and children on the opposite side but 7 ft. away! But it lends variety to the many forms and conditions under which trout are caught in Kashmir.

Suggestions: Undoubtedly the seasons and waters must be studied and selection made accordingly. When it gets warm and water is reduced the fish move up stream, and it is a fairly safe bet to find the best fishing in the upper reaches in September, and in April/May in the middle and lower beats. June is also good but at the end of the month snow water begins to come down and the afternoon fishing is often spoilt. July is a poor month in the snow-fed rivers, when fish are temperamental and will feed one day and not move the next, and sleeper or log floating is then in full swing.

Natural food and Culture: Mr. Malik and his staff are to be congratulated on the fine job they have done in restoring stocks in the face of great difficulties and an unenlightened public unaware of the time and labour involved in maintaining stocks of fish both in size and numbers, and the irreparable damage that is done if fish of all sizes are removed and limits exceeded. This leaves the Department working in the dark, and statistical data based on the entries in the watcher's books are not representative of the true facts, so that stocking is upset and fish suddenly become scarce. Watchers and Government shikaris are licensed to accompany anglers on all beats, but it is sad that a number of cases of these shikaris using frog and worm to make up the quota of disappointed anglers have been reported. This is a great shame as anglers should be the best field workers of the Fishery Department, and on them and their reports the warden should be able to improve the lot of all. We can only hope that, as the young school of anglers becomes conscious of these facts, conditions will improve. It was pleasing to see the old fidelity to past traditions growing among young army officers who are taking up fishing, and may we soon see camps as in the old days, dotted about over the beats and full notes of their observations in the watcher's books. There are no natural enemies—or at least I saw no traces of otter or eagles or fish hawks, except only the small kingfisher—and with the abundance of food in the form of frogs and tadpoles in their millions, willow moth, mayfly, beetles and grasshoppers, and fish breeding freely, we can look for better days than now.

Rods & Tackle: A nine-foot fly rod and reel to suit with 30 yards of tapered dressed line and 50 yards of backing is enough. 1 and 2 tapered casts for one dropper, and flies and lures as suggested later. A Threadline outfit or casting rod and levelwind reel for the big water should meet all requirements.

Baits & Lures: I found that dark rather than light flies were favoured at this time of year; at least this was my experience. Even the popular Coachman was disdained for Zulu, Watson's Fancy, Dunkeld, and Mountain Lady. The local shikari will press you, I suspect on a commission basis with dealers, to use Peacock lures, March Brown, and on some beats Teal and Green, but with the host of young anglers only beginning and all using these flies, I intentionally avoided as far as possible using these as every trout of size must have been pricked frequently by these roughly made lures on heavy long barbed hooks. I make my own flies to suit local conditions. At this time of year frogs and tadpoles are in their thousands and almost jump into your cup of tea; they certainly will share the tent with you, and the young rice is full of tadpoles making up the chief diet of trout. On several occasions I shook frogs and tadpoles out of the mouths of hooked trout, finding as many as 3 frogs at a time, and handfuls of black mess that was once tadpoles. I used a peahen wing feather for the wing and a silver or yellow body that worked well, and as a dropper a black body and tail with heavy black hackle and no wing. These took well in the rice areas. In the forest areas I found Alexandra and Mountain Lady most taking presumably because of the presence of beetles, both green and black, large numbers of which I found dead in the water or in the mouths of hooked trout.

There were of course days and reaches where anything would have been acceptable but, on the days when fish were off, these flies served me well. Lake and sea trout sizes are the best on a No. 8 hook, and lures on two hooks with body covered with lead foil to give weight.

Spinning is allowed on some beats in pools and in snow water, and the golden reflex minnow is most popular. I only used the spinner when I had to, and in all only caught 18 fish in this way on a brass fly-spoon or 1½ in. gudgeon, so cannot offer any suggestion, but there are plenty of large deep pools that will tolerate a heavy spinner as the water is big and fast.

Conclusion: This, then, is the picture of fishing in Kashmir today in the months of June and July. I fancy September would be even better, and have the additional attraction of excellent and easy chukor shooting in October, with monal and, snowcock and koklas and kalij in the upper forests.

| Beats | No. of days | Dates | Fish |  |  |  | Best fish | Returned |
|---|---|---|---|---|---|---|---|---|
|  |  |  | Allowed | Retained | Weight | Average |  |  |
|  |  | BHRINGI VALLEY |  |  |  |  |  |  |
| Bhringi, Upper ... ... | 7 | June 4th, 13–18th. | 42 | 36 | 24¾ lb. | 10 oz. | 2 lb. 12 oz. | 72 |
| ,, Middle ... ... | 9 | ,, 23rd, 5–11th. | 54 | 26 | 13 ,, | 8 ,, | 1 ,, 3 ,, | 25 |
| ,, Lower ... ... | 1 | July 6th. | 6 | 5 | 3½ ,, | 11 ,, | 14 ,, | ... |
| Bidhar ... ... ... | 3 | June 12, 19, 20th. | 18 | 18 | 13 ,, | 11·5 ,, | 1 ,, 5 ,, | 66 |
| Dyus ... ... ... | 2 | ,, 21, 22nd. | 12 | 12 | 12 ,, | 16 ,, | 1 ,, 8 ,, | 12 |
| Naubug, Lower ... ... | 2 | ,, 23, 24th. | 12 | 12 | 9½ ,, | 12·75 ,, | 1 ,, 2 ,, | 31 |
| ,, Middle ... ... | 4 | ,, 26–29th. | 24 | 20 | 18¼ ,, | 14·6 ,, | 1 ,, 12 ,, | 67 |
| ,, Upper ... ... | 3 | ,, 30, 2nd July. | 18 | 18 | 17 ,, | 15 ,, | 1 ,, 2 ,, | 45 |
| Kokarnag, Upper ... ... | 1 | July 4th. | 6 | 6 | 8½ ,, | 22·6 ,, | 1 ,, 13 ,, | 4 |
| ,, Lower ... ... | 1 | ,, 5th. | 6 | 6 | 9¼ ,, | 24·6 ,, | 2 ,, 4 ,, | 6 |
| Total ... | 33 |  | 198 | 159 | 128¾ | 13 | 2 lb. 12 oz. | 328 |
|  |  | LIDDER VALLEY |  |  |  |  |  |  |
| Wahdan ... ... ... | 4 | July 9, 10, 16, 17th. | 24 | 19 | 37 lb. | 31 ozs. | 3 lbs. 5 ozs. | 20 |
| Yenyer ... ... ... | 2 | ,, 11 and 12th. | 12 | 4 | 3¾ ,, | 14 ,, | 1 lb. | 5 |
| Batkut ... ... ... | 1 | ,, 13th. | 6 | 1 | 1 ,, | 16 ,, | 1 lb. | ... |
| Kotus ... ... ... | 1 | ,, 15th. | 4 | 3 | 5 ,, | 26·6 ,, | 1 lb. 12 ozs. | 26 |
| Total ... | 8 |  | 46 | 27 | 46¾ | 27·7 oz. | 3 lbs. 5 oz. | 51 |
| Grand Total ... | 41 |  | 244 | 186 | 185½ | 16 oz. | 3 lbs. 5 oz. | 379 |

## DETAILS OF SOME LARGE TROUT WITH LOCATIONS

| Length in Inches. | Bhringi, Bidhar and Dyus. | Name of Beat and weight in ounces. | | | | Remarks |
|---|---|---|---|---|---|---|
| | | Naubug. | Kokarnag. | Wahdan. | Kotus. | |
| 12¼ | 12 | 12 | ... | ... | ... | * Lean and unhealthy. |
| 13 | 16 | 17 | ... | ... | ... | |
| 14 | 20 | 20 | 19 | 22 | 19 | |
| 15½ | 24 | 28 | 26 | 29 | 25 and 28 | |
| 16½ | ... | ... | ... | ... | 37 | |
| 17 | ... | 32 | 33 | ... | ... | |
| 17¼ | ... | ... | 28* | ... | ... | |
| 17½ | 46 | ... | 36 | 36, 32 | ... | |
| 19 | ... | ... | ... | 53, 51 | ... | |

NOTE—Wahdan much the strongest fighters and fish in excellent condition.
The Naubug fish were a rich golden colour.
Bhringi and tributaries well stocked with fish and plenty from 4 inches upwards.
One fish in Kotus was lightly loaded with spawn (15th July).
Kotus full of choose. I caught five, best 2½ pounds. I caught one trout hunch-back of 9 inches.

# OBSERVATIONS ON THE POST-EMBRYONIC DEVELOPMENT OF *MACHAEROTA NOCTUA* DIST. 1916 (INSECTA: HOMOPTERA: CERCOPIDAE)

BY

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(*With a plate*)

A few species of this curious cercopid (Homoptera), whose nymphs live in calcareous tubes out of which they emerge only for moulting, were described by Westwood (1886) and Distant (1908, 1916) from Ceylon and India. The developmental stages of one species (*M. planitae*) are sketched by Lefroy (1909). Distant (1908) has given valuable bionomical notes relative to a closely allied species (*M. guttigera*) from Ceylon sent by S. Green to Westwood. Interesting as these accounts are, there are many details left unstudied. During the last year I noticed a heavy infestation by an allied species, *M. noctua*, on a small tree of *Phyllanthus emblica* in my garden in Trivandrum and the following is a summary of the observations I have been able to make on this during this period.

Adults, and eggs and nymphs of all stages in their tubes can be seen throughout the year, there being a reduction in numbers when the plant sheds its leaves and a maximum when the new leaves are put forth. The egg is a tiny oval body with a lateral compression at the broad end. By this end it is inserted into the axil of a leaf so that only the other half is seen outside. Examination of ovarian eggs in mature females showed that this lateral compression is present in them too—perhaps due to mutual pressure as the eggs enlarge. When the egg is laid, it is this compressed region that comes out foremost and naturally it is the part inserted into the leaf axil (fig. 1, *e*) like a wedge.

The egg is 720 microns long (fig. 5, *a*). When the young is about to hatch out, the upper part of the egg lifts off as a hinged lid and the tiny nymph comes out (fig. 5, *b*). It moves on the twig a little but immediately inserts the rostrum into the leaf stalk or tender twig, and in a short time it is seen surrounded by a tiny frothy mass. It protrudes and withdraws the posterior part of the abdomen and the frothy mass is slowly increased. When the twig with the frothy mass is put in a corked tube, this mass remains without hardening for several hours. But if exposed, the outer surface of the foam hardens in a few minutes forming a shallow minute turret on the twig surrounding the nymph. The turret is filled with a clear fluid in which the nymph lies immersed.

## THE NEWLY HATCHED NYMPH (FIG. 6, *a* and *b*).

It is of a dark brown colour anteriorly while its abdomen is yellow. On the ventral side of the abdomen the 5th and 6th sternites are of a bright orange coloration. The nymph is 0.7 mm. long[1]. Its eyes are ruby red and the antennae are rudimentary, lying glued to the side of the head. In the abdomen the hinder 3 segments are narrow but capable of great extension and contraction. They can be telescoped under the preceding segment or protruded considerably backwards. When protruded it can make lateral and rotating movements. At the hind end are two broad flaps or lateral valves united dorsally but free ventrally; these flaps surround the anal aperture. These extensile segments bear on their ventral surfaces a few highly transparent minute filamentous structures which however are seen better in the more advanced stages. They will be dealt with separately.

More and more of the frothy mass is formed, and by semicircular movements of the hind region of the abdomen it is daubed over the free edge of the turret, which soon takes the form of a tube. Thus a narrow tube is formed. It is of a dirty white colour. As the nymph grows and elongates, the tube also increases in length correspondingly by the addition of material at the free end. Each fresh addition, as it dries and sets, forming an integral part of the tube, is nevertheless separated by a distinct line from the part already existing —these serial circular lines may be called the 'lines of growth'.

### THE FIRST MOULT; SECOND INSTAR (fig. 7).

In about 8 to 10 days the tube has elongated to 2 mm. It is slightly curved and in some tubes there is a marked spiral curvature (fig. 2, pr. t.).

The nymph comes to the mouth of the tube covered by a mass of foam and undergoes the first moult. The moulted skin remains at the edge of the mouth of the tube and as the tube elongates, its fragments may be seen glued to the sides of the latter (fig. 1, r.m.). The newly moulted nymph gets back into the tube and takes up its position at the bottom with the rostrum thrust into the twig as before, and soon becomes bathed in a watery fluid.

The second instar nymph grows rapidly in size still retaining the appearance of the previous instar. The dark coloration however is lightened and the orange yellow patches have become intensified. The abdomen is proportionately longer. Soon after the moult it is 1 mm. long but rapidly grows to 1.8 mm. in length.

As it grows it adds on to the tube till the latter is 3 mm. long. The nymph which has evidently outgrown the dimensions—especially girth—of the narrow tube leaves the tube and undergoes the second moult, 8 to 10 days after its 1st moult.

### THE THIRD INSTAR (fig. 8).

The nymph after the second moult does not re-enter the original tube to continue life but moves along the twig a few paces and at a fresh spot, which may be just by the side of the original tube or a few millimetres or even centimetres away from it (figs. 1-4), fixes itself afresh thrusting its proboscis into the shoot and secreting the foamy substance around it. Solidification of the outer part of this foam soon forms a turret around the nymph. The circumference of this turret is much more than that of the earlier tube and the base of this turret is seen to almost completely encircle and grasp the twig.

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[1] All measurements are of specimens preserved in spirit.

The nymph is about 2 mm. long. Rudiments of the wings have become discernible in the thoracic region. The abdomen is proportionately longer and freely mobile; its wide sweeps rapidly add on layer after layer, as before, to this newly forming tube, which may be distinguished as the 'secondary tube'. The original 'first tube' or 'primary tube', as already mentioned, is discarded.

The nymph grows rapidly and correspondingly the tube also elongates (fig. 9). In 6 to 7 days the tube has elongated to 4 mm. The nymph comes to the mouth of the tube and undergoes its 3rd moult. As noticed before, the remnants of the exuvia remain glued to the side of the tube. The nymph after the moult re-enters the tube and continues to grow and add on to the tube.

## THE FOURTH INSTAR.

The nymph is 4 mm. long. Pigmentation of the body has become much lighter. The thorax is decidedly longer than in the previous stage. The head and thorax now measure 1.1 mm. whereas in the previous stage they measured only 0.7 mm. The abdomen is enlarged —segments 3, 4 and 5 being particularly large. The intersegmental grooves in this region of the abdomen are very distinct. On the sides, in the intersegmental grooves 2/3, 3/4, 4/5 and 5/6 are characteristic depressions. Of these, the depressions in the grooves 4/5 and 5/6 are much larger and more conspicuous than the others.

The nymph grows rapidly in size. In 3-4 days the nymph is about 4.5 to 5 mm. in length and the tube 6 mm. (fig. 10) long[1]. In another 4 days the tube has become 9 mm. long and the nymph is 6.5 mm. in length. Further growth is rather slow. In 7-8 days the tube has attained its maximum length 10.5-11 mm. The nymphs are at their maximum length now—6.5 to 7 mm. (fig. 11).

It is ready for the final moult. Prior to this moult however a reduction in the length of the abdomen is seen. The hinder abdominal segments get contracted effecting this shortening of the body. It leaves its position and, still covered by a mass of foam and froth, slowly moves to the mouth of the tube. Here it takes up its position on the rim at right angles to the length of the tube and undergoes the final moult[2]. The adult that emerges is very soft bodied—the wings are very short and unspread, and the spine soft and flexible. Its coloration also is very light. It remains for a considerable time on the edge of the tube, till the body hardens and the wings spread. The nymphal exuvium remains glued to the mouth of the tube by the hardened foam, declaring that the adult has emerged from the tube. The emergence has been noticed taking place in the early hours of the morning, and the adults fly only when the morning is well advanced

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[1] The pronotal spine is quite distinct at the stage.

[2] This is the 4th moult. It is possible that there is a moult prior to this which I have missed.

(figs. 1 and 3 m.). The adult is figured by Distant in Fauna of British India, Rhynchota, Vol. VI (1916).

The interesting nymphal stages of this homopteran are thus seen to be spent in two successive tubes—the first, termed the *primary tube* (figs. 1-4, pr.t.), is a small tube which houses the early tiny stages and the second—the *secondary tube* (figs. 1-4, sec.t.)—a larger tube, enclosing the later larger stages. Since the nymphs do not move much, getting out of one and beginning the other, these tubes are often seen close together and sometimes groups of small and large tubes can be seen arranged side by side on the same twig (Fig. 1). In view of this observation some of the early interpretations of the function of the smaller tubes (Lefroy 1909) may have to be discarded.

In the morning hours and towards evening copious drops of a clear liquid are seen exuding from these tubes—actually the rectal secretion of the nymphs. At other times also these secretions may be noticed dropping out of the tubes but only to a lesser extent. The secretion is a clear watery fluid, sweet to taste. It may be kept for hours but does not solidify. Examining a tube when the secretion has begun to drop, it is seen that this fluid fills it and that the nymph inside is completely bathed in it. As more fluid is excreted by the nymph, the excess naturally flows out through the opening of the tube. When the sky is clear in the evenings the continuous drops that fall from the innumerable tubes appear like drizzling rain. When the foamy secretion hardens to form the case around the nymph, this watery fluid bathing the body appears to keep the nymph safe from being entombed within the hardening mass. The secretion forming the frothy mass is produced at intervals and, as it is produced, it is spread out or daubed as a layer at the edge of the tube by the skilful manipulation of the extremely mobile hinder segments of the abdomen. Here it soon solidifies, adding to the length of the tube.

This addition of material at regular intervals gives rise to the characteristic transverse annulations clearly seen on the tubes and called above, 'the lines of growth'. In a fully formed 'secondary tube', there are 40 to 45 lines of growth and a study of the life history has shown that this tube has been completed in 20 to 22 days. This indicates that twice every day the nymph adds on tube-material causing its 'elongation'. There must evidently be an interval between these two daubings, for the first must dry before the second can be applied along its edge. The nature and origin of these secretions is being studied in detail.

The brittleness of the tube is due to the calcareous matter it contains. This can be dissolved out in acid and then the organic matrix remains retaining the original shape of the tube. This however is now quite flexible and may be formed of mucoid or cuticular material.

## SUMMARY

The Cercopid genus *Machaerota* has several peculiarities. The adults differ from all other Cercopids in possessing a disproportionate pronotal spine like the Membracids, while the nymphs have the most curious habit of making calcareous tubes in which they live. The successive stages in the life history of *M. noctua* are traced and the

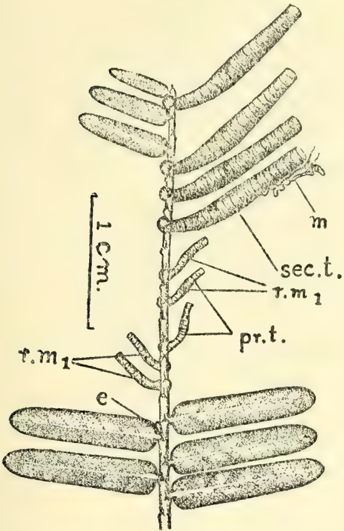
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Fig. 1.

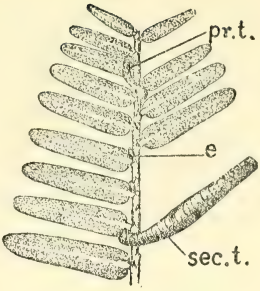

Fig. 2.

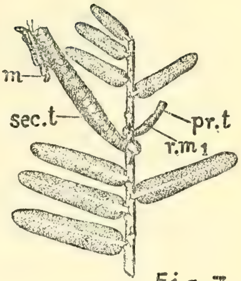
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Fig. 3.

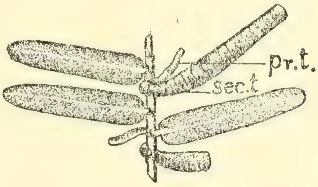
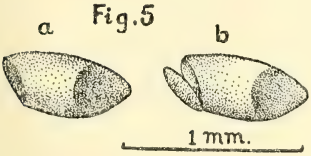


Fig. 4

Fig. 5



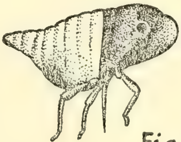


Fig. 6a.

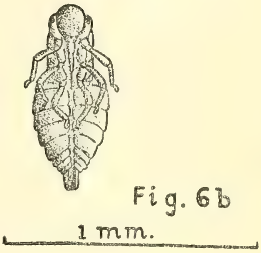


Fig. 6b

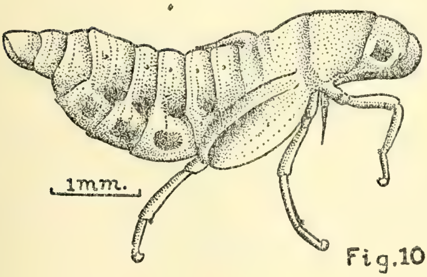


Fig. 10

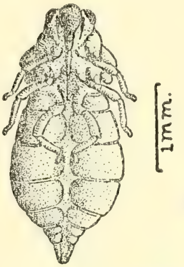


Fig. 8b

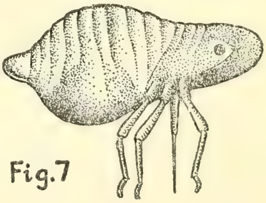


Fig. 7

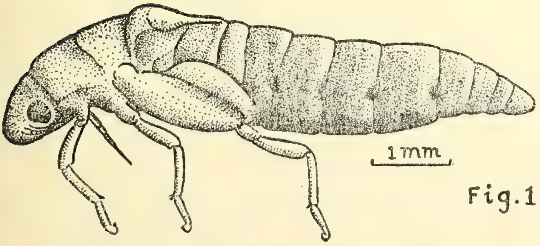


Fig. 11

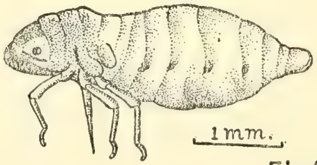


Fig. 9.

*MACHAEROTA NOCTUA* DIST.

(Explanation of Figures at end of article)

relation of the instars to the tubes in which they live is shown. The tube material is 'the spittle' so characteristic of the Cercopids, but used in a remarkable way. The life-cycle is completed in *two* tubes—the 'primary tube' being a slender narrow tube lodging the tiny early nymphs, and the 'secondary tube' secreted by the enlarged nymphs of the advanced stages. Usually these two tubes are found side by side and older observers, perhaps failing to understand the role of the narrow tube (primary), suggested that it may be for aeration. The nymphal instars of which there are four, last as follows:—

1st instar 8-10 days; 2nd instar 8-10 days: (In primary tube).
3rd instar 6-7 days; 4th instar 15-18 days: (In secondary tube).

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,, (1916): Fauna of British India, Rhynchota Vol. VI. pp. 183-184.
Lefroy, M. (1909): Indian Insect Life, pp. XII+1-786. Plate LXXXIX, p. 733.
[1] Westwood (1886): *Trans. Ent. Soc. London,* p. 329.

## EXPLANATION OF FIGURES

FIG. 1. A twig of *Phyllanthus emblica* with tubes of the nymphs of *Machaerota noctua.* FIGS. 2, 3 & 4. Twigs of *Phyllanthus emblica* showing different arrangements of the primary and secondary tubes. FIG. 2 shows these tubes at some distance while in FIGS. 3 and 4 they are close together. FIG. 5*a.* An egg removed from the leaf-axil (lateral view). FIG. 5*b.* Empty egg case after the emergence of the nymph. FIG. 6. Newly hatched nymph. *a*—side view. *b*—ventral view. FIG. 7. 2nd instar nymph. FIG. 8. 3rd instar nymph. FIG. 9. 3rd instar nymph—late stage. FIG. 10. 4th instar nymph. FIG. 11. Same, prior to the final moult.

## ABBREVIATIONS USED

e—egg in the leaf axil. m—moulted skin of the last nymphal stage attached to the end of the secondary tube. pr.t.—Primary tube. r.m$_1$.—Remnants of the first moult persisting on the side of the primary tube. sec.t.—Secondary tube.

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[1] Not seen in the original.

# HEDGEHOGS OF THE DESERT OF RAJASTHAN

BY

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## Part II. Food and Feeding Habits

### Introduction

This is the second paper of the series[1] on the habits of the hedgehogs, *Hemiechinus auritus collaris* Gray and *Paraechinus micropus micropus* Blyth, found in the desert of Rajasthan. These animals are popularly believed to destroy vegetation, especially modified stems and roots (Adams, 1899), but are generally seen under light posts at night feeding on insects. This contradiction between popular belief and observed fact led us to plan an investigation and study of the feeding habits of these curiously unsocial animals under various conditions in nature, in semi-captivity and captivity. The contents of the stomachs of many hedgehogs were examined soon after they were captured. Care had been taken to catch them after their feeding time. The conditions of semi-captivity were the same as described in the first part of this paper. Under these conditions they were presented with a wide variety of substances, both of animal and of plant origin. These substances were offered separately and also together in various combinations to find out their food preferences. A good number of animals was taken for each experiment.

Hedgehogs being nocturnal remain hidden in their burrows throughout the day, but at dusk they come out for feeding. After trotting about for five to six hours in search of food, they again cease their activities and roll up to sleep. If food is available they can take it in large quantities. Some of the alimentary canals which were examined were completely packed with the chitinous remains of the bodies of the 'Dung-Roller'.

### Food in Nature

To ascertain their food in nature a number of both *H. a. collaris* and *P. m. micropus* were dissected immediately after their capture. The following were the undigested remains of food in the stomachs of the hedgehogs :

1. Wings resembling those of *Bucephalus helicopris*.
2. Elytra of several beetles (unidentifiable).
3. Hard bony pieces (probably amphibian).

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[1] Part I, *JBNHS*, **53** (1) : 38-43—Aug. 1955.

4. Pieces of skin, amphibian as well as mammalian.
5. Thread-like flexible tendon.
6. Chitin pieces, of which those from Dung-Roller and *H. bucephalus* could be identified.
7. Spiny hook of some insect leg.
8. Small pieces of spines of *H. a. collaris.* (Only in one stomach of *H. a. collaris*).
9. Complete, slightly disintegrated beetle, *Helicopris bucephalus.*

Contents of the alimentary canals of hedgehogs did not show any traces of vegetable matter, although the contents were thoroughly examined under the microscope.

### FOOD IN SEMI-CAPTIVITY AND CAPTIVITY

In semi-captivity the food was provided to them in the evening, and n captivity in early morning. For capturing an animal, it was observed that they chased it with appreciable speed and attacked it, usually on its head. After eating the prey, its remains were generally taken to the burrow for future use. The following substances were tried in different conditions. 25 hedgehogs, 13 *H. a. collaris* and 12 *P. micropus*, were used for the experiments.

| Expt. | No. of animals | Conditions | Food given | Observations | Remarks |
|---|---|---|---|---|---|
| 1. | 5 *a. collaris* and 5 *m. micropus* | Captivity | Earthworms, living and chloroformed. | Not taken | ... |
| 2. | 13 *a. collaris* and 12 *m. micropus* | Captivity and semi-captivity | Beetles, locusts, crickets, mantis, larvae of many insects, neuropterous and lepidopterous insects and termites etc., living and chloroformed. | Taken | The actual food in nature, *Helicopris, bucephalus* was preferred to all other insects. |
| 3. | 13 *a. collaris* and 12 *m. micropus* | Captivity and semi-captivity | Ants, bees, wasps etc., killed with KCN bottle. | Not accepted | ... |
| 4. | 2 *a. collaris* | Captivity | Scorpion,<br>(*a*) living<br>(*b*) killed. | (*a*) Not accepted<br>(*b*) taken | Even the sting was taken. |
| 5. | 5 *a. collaris* and 5 *m. micropus* | Semi-captivity | Snail, living. | Not taken | ... |
| 6. | 10 *a. collaris* and 10 *m. micropus* | Captivity and semi-captivity | Toads (*Bufo arenarius*) and Frogs (*Rana tigrina*), living. | Caught, killed and eaten | Even the bones were taken. |

| Expt. | No. of animals | Conditions | Food given | Observations | Remarks |
|---|---|---|---|---|---|
| 7. | 5 *a. collaris* and 5 *m. micropus* | Captivity | *Uromastix hardwickii*, living. | Not attacked | ... |
| 8. | 5 *a. collaris* and 5 *m. micsopus* | do. | *Uromastix hardwickii*, chloroformed with ventral incision. | Viscera and the tail taken | ... |
| 9. | 1 *a. collaris* | do. | *Varanus monitor*, living. | Not taken | The tail of the *Varanus* was caught firmly by the hedgehog between its jaws. The lizard attacked the hedgehog furiously and in doing so its mouth was injured severely. |
| 10. | 5 *a. eollaris* and 5. *m. micropus* | do. | *Varanus monitor*, chloroformed with a ventral incision. | Viscera taken | ... |
| 11. | 1*a. collaris* | do. | *Eryx johnii* (Nine inches long), living. | The entire animal was taken | ... |
| 12. | 1 *a. collaris* | do. | *Ptyas mucosus* (13″ long), living. | Taken | The hedgehog caught it by the tail and rolled over it, to give chance to the snake to strike against its spiny armour. In doing so the snake succumbed to injuries & was devoured. |
| 13. | 5 *a. collaris* and 5 *m. micropus.* | Captivity | Pigeon (*Columba livia*), living. (Its wings were broken) | Viscera taken | The main point of attack was the anus. |
| 14. | 13 *a. collaris* and 12 *m. micropus.* | Captivity and semi-captivity | Eggs.<br>(*a*) Hen,<br>(*b*) Pigeon. | (*a*) Not taken<br>(*b*) Taken | (*a*) The contents were sipped when provided in a plate.<br>(*b*) The egg was broken by pressing it between the jaws. |

| Expt. | No. of animals | Conditions | Food given | Observations | Remarks |
|---|---|---|---|---|---|
| 15. | 5 *a. collaris* and 5 *m. micropus.* | Captivity | Rats, (*Rattus rattus*), living. | One was caught, killed and its viscera was taken | Prey was killed by biting its legs and face, and was shared by all the inmates of the cage. |
| 16. | 13 *a. collaris* and 12 *m. micropus.* | Captivity and semi-captivity | Rats chloroformed, with ventral incision | Viscera taken | ... |
| 17. | 10 *a. collaris* and 10 *m. micropus.* | do. | Gerbilles (*Meriones hurrianae* and *Tatera indica*), chloroformed, with a ventral incision. | do. | ... |
| 18. | do. | do. | Squirrel (*Funambulus pennanti*), chloroformed, with ventral incision. | do. | ... |
| 19. | do. | do. | Rabbit (*Lepus dayanus*), chloroformed, with ventral incision. | do. | Very often the living animal was attacked. Once the hedgehog injured it severely on the medial side of the thigh. |
| 20. | 13 *a. collaris* and 12 *m micropus.* | do. | Bats (*Rhinopoma kinneari*), living. | The entire animal was taken except the patagium | ... |
| 21. | 13 *a. collaris* and 12 *m. micropus.* | Captivity and semi-captivity | Meat of goat, fresh. | Taken | In captivity it was the most relished food and pieces of lungs and liver were preferred. |
| 22. | do. | do. | Milk of cow and buffalo, fresh, boiled and sugared. | do. | Less preferred in captivity but in semi-captivity the hedgehogs survived mainly on milk. |
| 23. | 10 *a. collaris* and 10 *m. micropus.* | Captivity | Gram, wheat, barley, millet and rice, etc. | Not taken | When mixed with cow-dung some grains were picked up. |

| Expt. | No. of animals | Conditions | Food given | Observations | Remarks |
|---|---|---|---|---|---|
| 24. | 13 *a. collaris* and 12 *m. micropus.* | Captivity and semi-captivity | 20 common vegetables. | Not taken. | ... |
| 25. | do. | do. | 10 entire plants found in the same locality where the hedgehogs were collected. | do. | ... |

The interesting feature of the feeding habits of these hedgehogs was that they developed a cannibalistic tendency in the presence of a dead companion. Whenever a dead hedgehog was placed in the cage its inmates rushed to the carcase and started feeding on it, beginning with the viscera (Prakash, 1953). They were observed to be very fond of their own young ones ; even the mothers fed upon their progeny (Prakash, 1955). They also showed remarkable resistance to hunger and thirst. In cages they could be kept alive without food and water for four to six weeks. At one time two of them (*H. a. collaris*) were locked by mistake in the laboratory. On reopening after 10 weeks the hedgehogs came out alive.

## SUMMARY

1. A wide variety of substances was presented to captive and semi-captive hedgehogs to find out their food preferences.

2. Alimentary canals of freshly caught hedgehogs were examined to investigate their food in nature ; which was mainly non-vegetarian.

3. Hedgehogs, *Hemiechinus auritus collaris* Gray and *Paraechinus micropus micropus* Blyth prefer insects and fresh goat meat in captivity and milk in semi-captivity.

4. Hedgehogs did not take any plant or vegetable in captivity and semi-captivity ; moreover no plant tissue was found in the contents of their alimentary canals.

## ACKNOWLEDGEMENTS

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# THE MALAYAN GREAT TIT

BY

JAMES CAIRNS, M.C., M.B.O.U.

(*With a plate*)

The Malayan Great Tit (*Parus major ambiguus*) is so severely limited in local distribution that, for this reason alone, it must be considered a very rare bird; and as far as I am aware it never has been recorded from any Malayan island large or small. Nevertheless for the past thirty-five years, to my knowledge, it has been a resident and breeding species in Penang Island. Malay residents of venerable age with whom I frequently converse have known the bird since boyhood, back to 1885. Its home is the seven-miles-long mangrove forest reserve on the west coast, the width of which varies from one hundred yards to half a mile. After years of intimate association with this reserve I estimate that the Great Tit population is, at the very least, in the region of 50 pairs per mile and is probably twice this number. The bird also has inhabited for a similar length of time the vast mangrove forest which engulfs the estuary of the Sungei Merbok, West Kedah, where it is equally numerous; and it is indeed surprising that no ornithologist past or present ever has reported its presence from either habitat. The published annals of distribution areas are therefore woefully incomplete.

The Malay name of the Great Tit is *chiak bengala bakau*, the probable origin of which could be the bird's white-cheeked resemblance to the Java Sparrow, whose Malay name is *chiak bengala subang*. The two, however, have no further similarity.

One of my perennial habits has been to visit the tits' reserve once every week and through such persistent continuity I have amassed considerable information concerning the life, domestic economy, habits and ecology not hitherto known or recorded. This paper is a collated and correlated presentation of important essentials and characteristics of a wonderful little bird.

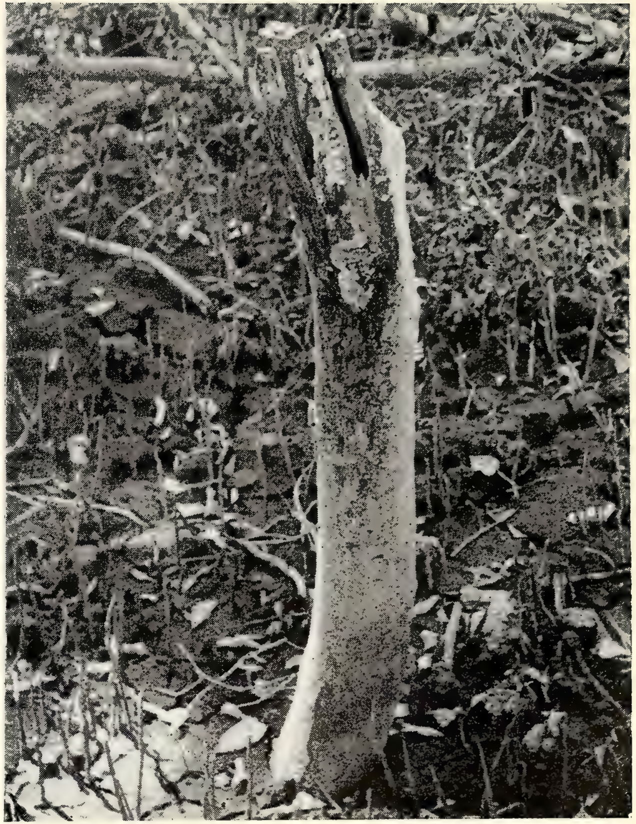
Methods of food-searching are typically tit-like: hanging inverted from sprays and twigs; stretching out from very slender perches; carrying dead leaves sometimes much larger than themselves to any convenient place and standing on them with both feet while they probe every curl and curve. They are particularly partial to exploring dead leaves on the ground itself, and tangles of storm-broken boughs strewn about the glades, making many trips from this debris up to the canopy and from the canopy back to the ground during their feverish restless rummaging. They drink rain water from holes high up in trees. In this forest paradise they have no fear of man and feed without the least concern at very close range. They may on occasion be seen in young mangrove saplings, but their real love is the older trees. They constantly associate in due season with

Arctic and Crowned Willow Warblers (*Phylloscopus b. borealis* and *P. i. inornatus*), White-eyes (*Zosterops p. williamsoni*) and Fly-eaters (*Gerygone sulphurea*) feeding and singing and moving together: the first two species often in great numbers. On such occasions, and in such mid-March gatherings, the tits utter what I consider to be their true nuptial song. The forest rings with these wild, clear, tempestuous phrases *te-bet-chu, te-bet-chu, te-bet-chu* (accent on the middle syllable) repeated over and over while glancing through and gracing the canopies. Prolonged experience and accumulated evidence have convinced me that pairs occupy definite territories and zones of activity. They have their feeding circles and cycles. They have their favourite glades where one may see as many as 20 pairs at a time communally preening, singing, feeding and flirting: and again there are glades where no tits ever come. The bird is not what I call an early morning exhibit. The best hours of the day for viewing it are between noon and 5 p.m.

Like all tits our bird occupies a favourite nesting site year after year so long as it lasts. One of many known to me is a small api-api stump only about 3 ft. high and 5 in. in diameter, which has been occupied by a pair for the past seven consecutive seasons, and it still stands. The cavity walls have become smooth and shiny from long use. The stump, semi-decayed, stands in a transept of scattered tall trees and the sun shines on it only for one short hour of the long day. At this spot on 16th January 1955 a beautiful male Great Tit suddenly appeared some 20 ft. to my right, greatly agitated and uttering a continuous stream of rapid notes *rrrr-chi-chi chi-chi-chi* followed by a running *churrr* and flirting its tail and wings in unison. Presently it flew to the nest stump which has a three-way split top. After some tilting and testing it disappeared by sliding down the entrance funnel head first. In about a minute it was out again, then in again, then out, calling incessantly. At this point the female appeared from nowhere and joined the male on the stump. The male's notes then changed to *pe-lay pe-lay pe-lay pe-lay*. (All the black of the female's plumage is less intense than the male's and her central under-body band is narrower; but each sex has a small grey-white notch inset at the base of the black nape.) She slid into the cavity without hesitation, emerged, went in again and then out. Both birds appeared to enjoy themselves thoroughly by wriggling upwards through the narrowest of the three exits. Eventually they drifted off together down a corridor of green light. This is typical of the site-prospecting and frolicking that begins in December and goes on through January, February and early March.

It is positively amazing how these birds start bustling and building almost to the day —the third Sunday in March— year after year. On 20th March, two pairs of tits were seen in mixed leafy and dead scrub at ground level. Both females were collecting what appeared to be shredded bark or fine fibres while the males attended but did no collecting. The take-off was awaited with quiet concentration for it is no easy matter to follow, even with binoculars, the fast flight of such small grey birds through sun-and-shadow-dappled forest. A second factor which increases the difficulty is that the birds change

Mangrove home of the Great Tit.



Nest site of the Great Tit in three-foot high stump.

*(Photos: J. Cairns)*

their relative positions during flight. The first pair to depart were almost immediately lost in transit behind massed foliage but the second pair, travelling through older forest, were successfully marked down 150 yards from my viewpoint. Both birds stopped on the same bough of a leafy tree, then some moments later the female flew to the apex of an isolated tree-stem standing in a glade, and at once dived vertically down a cleft just below the summit with her crowded beakful of fibres. On emerging both flew off in a direction away from me. The normal routine of all building pairs I have ever seen is the same. Females collect materials and shape the nests while males accompany their partners on all flights at this period; but later on males spasmodically help to construct second nests. The stem on closer examination proved to be very decayed indeed. For this reason it could not be climbed nor could it be successfully viewed from any adjacent height. The entrance to the nest was on the north side about 1 ft. below the summit which was judged to be 13 ft. high. It was not a site which, without preknowledge, one would examine in casual passing. There being no necessity to inspect at this stage, withdrawal was made without disturbing tree or nest.

On 27th March my Malay climber and I returned with a 15 ft. ladder. The stem, however, was too frail to support even the slight weight and so I held the ladder erect close to the tree while Rali gingerly eased his way upwards. With the aid of a torch he was thus able to peer into the cleft without touching the tree. He reported the nest held no eggs but appeared to be complete and made of soft substances which could not be identified in the meagre light. It was 7¾ in. down the stem from the lower lip of the entrance and completely filled the width of the cavity bottom.

We returned again on 3rd April and on reaching the tree stem tapped it gently and out came the female tit immediately. She flew off without any undue protest. This order of things is completely reversed when incubation is advanced. Some birds refuse to leave the nest and may be lifted out; but from those that do, scoldings are eruptive and vehement. Repeating last week's procedure I held the ladder upright and in due course Rali reported the nest contained five beautiful eggs. These were chalk white, slightly glossed, thickly freckled with liver brown over the large ends, while the lower halves of the shells bore few spots. The grouping on one egg was dense enough to form a cap. They measured 17 × 13, 17 × 12, 17 × 14, 16 × 13, 18 × 14 mm. The nest was shaped like two-thirds of a saucer, this being the shape of the hollow it filled, and along the 'straight' third which was actually a flat curve, measured 3 in., and the diameter 2¾ in. The whole structure was amazingly shallow, 3/10 of an inch only at the deepest centre of the interior, and only a ½ in. thick at the thickest part of the material which in places was less than a ¼ in. thick. Like all tits' nests previously seen, this nest was unique in these respects, and also in the composition of its fabric. The interior was completely black; composed of a uniform layer of very fine hair-like fibres probably collected from tidal debris, overlying and woven into a lower layer of beige-coloured vegetable felt probably collected from swamp sedges. Below the felt was a second layer of black fibres, and below these a second discontinuous layer of cinnamon-coloured felt. Throughout, the lower layers and nest rim were stiffened with fine wiry grass threads. At one point on the edge of the structure were two small tangles of white spider silk; and the eggs lay on tufts of dark-tipped grey rat's fur. The presence of wiry grasses and vegetable felts denotes journeys outside the forest to obtain them. Wood chips, if any, below a nest are entirely fortuitous. Nests are always very simple, very shallow, neatly moulded by the sites containing them, and have burnished black interiors.

While at the nest I recorded several new song and call phrases. If separated in flight or in different trees the notes were *tee-hoo-hee, tee-hoo-hee,* followed by *chiky chiky chiky chiky chiky.* Constantly uttered was a swelling phrase sounding exactly like *te-pel-weetyu, te-pel-weetyu. Pray-tay-tay-tay-tay* was a rapid alarm: a soft *choorip-choorip-choorip* never ceasing when entering or leaving: and when food hunting the call became a double syllable, the first accented — *teehu-teehu-teehu*— very like the see--saw notes of the European Great Tit. On the point of leaving I saw the female take fresh material into the nest which may have been to repair minor displacements; while the male, idling in thin foliage, sang *—tay-cheetsaway-cheet, tay-cheets-away-cheet*— softly and sweetly to himself.

A week later I was astonished to discover a second pair of tits building in the south side of the same tree stem, just 2 ft. below the occupied nest. Great Tits were everywhere and their loud clear calling *wheest-tu-wheest, wheest-tu-wheest* made the forest resound. In one hour I saw 12 pairs.

Although I visited the reserve as usual on 17th and 24th April I did not go near the nesting tree on these dates; but on my 1st of May visit I saw the male feeding his full-fledged family. While the parent was away foraging, the young also foraged on their own but were not observed to collect anything. The male fed each young bird in turn and on his every approach there was great agitation: fluttering, gaping and fluffing of feathers. After being fed they continued to explore leaves while the male preened. The female did not once appear. Young birds are strikingly different from adults. The whole head, nape, throat, breast and under-body band are grey not black. The band itself is very narrow and runs down only as far as the lower breast, fading out altogether before reaching the position of the legs; whereas in the adult it runs right along the abdomen, between the legs and over the vent to the tail. The edges of both mandibles in the young are pale yellow-white; the inside of the mouth is flesh-coloured, and the white cheeks are filmed with grey. Near this family I found myself surrounded by a party of six adult tits. In a phase of a fracas between two males one bird, which was hanging by its feet head down and swinging up to peck at the other perched immediately over it, was visibly surprised when the upper bird dropped below it and hung itself by its feet from the hanging bird's legs. The added weight broke the grip of the latter and the falling birds almost hit the mud before they separated and flew off.

May 8th was a day of monsoon rains and violent winds. While sheltering in a pondok[1] quietly enjoying a pipe two male tits came out of the mangrove and perched on high, half dead trees standing in an open swamp close by. From these stormy heights they sang a song-phrase, new and unforgettable, for a continuous period of twenty minutes before returning to the rain drenched forest. In a wilderness so wet the song itself had a liquid, storm-tossed quality: *wet-it will wet you-will wet you-will wet you: wet-it will wet you-will wet you-will wet you* is an almost exact rendering. At any rate by repeating it I can relive the rapture and sense the storm.

Throughout May the mangrove is rich with flying first broods, but in the first week of June second clutches are being laid in the same nests, or second nests are being built in new sites. Incomplete nests, complete nests without eggs, fresh eggs, incubated eggs or newly hatched young may be found through June and well into July on the same day. This necessarily means late July nests provide discoveries of incubated eggs in August, but I have never known a single instance of a clutch being laid entirely in August or, at the inception of the season, in February. Egg-laying occurs from March to July inclusive with some incubation overlapping into August; and so the forest remains clamorous with fledglings into September.

Confined as it is strictly to the mangrove belt one naturally expects all nests of the Great Tit to be in the mangrove belt. This, however, is not the case. In recent years a phenomenon has developed which is fantastic but true. Many pairs breed outside the forest altogether though adjacent to it. These nests are at comparatively great heights from the ground in holes of isolated dead trees which have been left standing in a felled area. On 5th June I watched a male for half an hour as it made a wide circuit of such trees before entering a hole in one only 60 ft. from where it started and from where I was standing. This detour appeared to be a deliberate attempt at deception. Measured exactly by rope the site was 71 ft. from the ground on the south side of the hole. The nest was an oblique 7 in. from the entrance which was very narrow indeed, a mere 1.6 in. in diameter. Thirty ft. higher in an adjacent tree was an old Serpent Eagle eyrie. Both tits were seen to enter the hole with materials, one waiting till the other came out. At such a height in such a tree standing in denuded land one would never dream of looking or expect tits to breed. The whole width of the male's chest was black and the central body band very black and broad. This is usual in full breeding plumage. Flight is fairly fast, somewhat jerky but more or less straight and lacks the erratic side-slipping of the sunbirds. A week later—12th June—the nest contained one egg, and five eggs two weeks later—19th June. There were, however, only three newly hatched chicks on 2nd July. I suspect a lizard which I saw come out of the hole, of having eaten two. The three flew on 16th July. Also on 5th June, two miles further north, a second nest was located. A male in fine fettle and plumage was seen coming *out* of the mangrove with materials which it carried to one of a group of trees standing in the open. The chosen hole was again facing south and was 92 ft. from the ground. On 26th June it contained seven eggs, five of which hatched on 9th July when 2 addled eggs were removed. The young flew on 23rd July.

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[1] A small thatch hut for shelter from rain and sun.

Again on 12th June in the same region two more nests in similar situations were marked down in the same way. The first of these was in the extreme end of a broken bough curving south at a height of 40 ft. up a 100 ft. dead tree. When my Malay climber was out on the limb, just 6 ft. behind the entrance, the female flew out and perched close to his head, bobbed and curtsied, wove from side to side, flirted her wings, spread her tail and uttered a plaintive *chi-choo-it, chi-choo-it* continuously. The total length of the horizontal hollow was 5¾ in. and the nest was half way in and not at the end, lying in mid channel as it were, with the outer rim 2½ in. from the entrance which was 2¼ in. in diameter. Strangely enough the nest though complete held no eggs. When Rali was 8 ft. below the limb on his way down, she was back hanging inverted by both feet to the lower edge of the entrance. From this position, like an acrobat on a trapeze, she levered herself up and in with a single thrust. During the descent the tree vibrated with heavy movement but she did not come out. In the circumstances I can only assume that her anxiety to return to the nest may have been due to the imminent expulsion of her first egg. At any rate there were five eggs on 18th June. On account of the frail state of the tree it was not climbed again, but I saw a family of five young with the parents on 16th July. Later in a storm the limb broke off. From it I recovered the nest and found it to be an abnormally compact unit of rats' fur lightly laced with the usual fibres and felts. The male of this pair was observed to catch a medium sized butterfly with sand-coloured underwings which was carried in the bill to a high branch. Pinning the insect under its feet the tit pulled off both wings and dropped them, then proceeded to devour piecemeal the whole of the inch-long thickish body. On 24th July this experience was repeated. A friend and I saw a male tit pull the wings off a pale yellow and brown-winged butterfly and pass the body to a fledgling. The second site was at a height of 85 ft. on the inevitable south side and contained a half made nest. On 26th June it held five eggs which were successfully hatched and the young seen on 31st July. New call phrases uttered by this pair and carefully recorded were a soft anxious *chee-pee, chee-pee,* a cheery *yur-tu-erly, yur-tu-erly* and a spirited *chi-cher-o-ki-kee, chi-cher-o-ki-kee* when screened from each other.

To appreciate fully the significance of this exodus from the forest for nesting purposes it is, I think, necessary to state these facts. Up to 1947 the mangrove was 100 to 500 yards wider than it is today throughout its whole length. In the years following, these widths were felled after a bund had been constructed to cut off the sea from the planned reclamation. But for reasons unknown many single trees and groups of trees were left standing in the great denuded areas of now rotting stumps, prostrate trees, tangled scrub and rank grasses, and with the passage of time are slowly dying, or have died, from lack of salt water. It is therefore probable that the pairs now nesting in the open are instinctively returning to nesting sites which were once deep in the forest. It might well be that, as the result of the encroachment of man, the tits may soon spread eastwards to the kampongs[1] which are not so very far removed from their present secluded sanctuary.

## SUMMARY

The Malayan Great Tit is a resident breeding bird in Penang Island. This is supported by the writer's personal knowledge of the fact covering a period of 35 years and by statements made by reliable local Malays who can remember the bird since boyhood as far back as 1885. The combined sources of evidence thus account for a period of 70 years.

The bird is confined to the west coast mangrove belt where the present population is estimated to be between a minimum of 350 pairs and a maximum of 700 pairs. But in recent years many pairs have bred in cleared areas adjacent to the mangrove.

Diet includes butterflies taken on the wing.

Indifference to danger and extreme curiosity are inherent characteristics.

Nuptials begin in December; and the egg-laying season extends from mid-March to mid-July with some incubation overlapping into August.

At least two, sometimes three, broods are reared by one pair in a single season. The full clutch of eggs is normally three, five or seven (in not a single instance out of more than 300 nests examined has a bird been found brooding two, four or six eggs). Incubation lasts 14 days; and the young fly on the 14th day after hatching. Nesting sites vary in height between 3 ft. and 92 ft. above the ground. Call and song phrases present great variety in tempo, quality and character, and those recorded are probably far short of the full range.

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[1] Habitations.

# SOME ZOOLOGICAL PROBLEMS ASSOCIATED WITH HIGH ALTITUDES OF THE HIMALAYAS[1]

BY

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*Zoological Survey of India, Calcutta 13*

(*With a map*)

## Introduction

Any form of life, at a given time, represents the product of the interaction of its environment and heredity. The environment has indeed a key-rôle in the process of evolution. A correct appraisal of the mechanism of evolution cannot, therefore, be made without a thorough study of the environmental factors through which life passed and is passing, and their effects on the living things.

For the purpose of biological studies, the earth is divided into a number of ecological zones, each of which has its own distinctive characteristics. The zones have, moreover, similarities with one another. Though for various reasons one cannot delimit such zones into water-tight compartments, yet it is perhaps possible to define certain geographic areas possessing certain specific attributes and supporting a certain type of life. High altitude is one such ecological zone, and its environmental factors differ substantially from those of lower elevations.

## Definition of High Altitudes of the Himalayas

From the point of view of physical geography it is possible to define a particular elevation limit above which everything may be termed as 'high altitude', but as a biologic environment the definition of high altitude should not depend entirely upon the elevation of land above mean sea level for reasons set forth below.

The Joint Commission on High Altitude Research Stations in its report (see Korff, 1954) has defined 'high altitude' as regions 'in excess of about 7,500 ft., or about 2,000 meters.' Unfortunately, nowhere does the report give any basis for this definition. This report reveals that most of the high altitude research stations listed in it are solely or mainly for the study of the physical sciences; that the few stations where biological investigations are or can be conducted are situated between 10,000 and 14,000 ft., the only three exceptions being established at fairly northerly latitudes (34°N 47° 19′N); and that the only station of the Himalayas viz. Gulmarg Research Observatory, Kashmir, is located at about 9,000 ft. at 34°N. These would tend to show that factors for researches in the physical sciences have been mainly considered in adopting the above definition by the Commission. Besides, many people, including some biologists, have a rather vague conception of what constitutes the high altitude zone for biological purposes, and different altitudinal figures ranging between 5,000 and 10,000 ft. have often been quoted as the lowest limit of 'high altitude'. From my personal acquaintance with animals at high altitudes in Sikkim[1], and in the Mount Everest area of Nepal as a member of the *Daily Mail* Himalayan Expedition 1954 (Biswas and Khajuria, 1954; Izzard, 1955; Biswas, 1955), I find, however, that the Commission's definition seems hardly tenable in so far as the Himalayas are concerned. And, I am sure, biologists with first-hand knowledge of animals and plants of the high Himalayas and the environment in which they live will agree with me.

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[1] Published by permission of the Director, Zoological Survey of India.

The 'high altitude zone' as a biotic environment possesses certain attributes which have a definite and understandable effect on the life that exists there. The most obvious physical factors of high altitudes are reduced atmospheric pressure, low temperature, and high light intensity. There is no doubt that they have an important bearing on the physiological processes of organisms living there.

While the fauna of high altitudes of India is only perfunctorily known, the floristic studies demonstrate interesting gradations in the forest types as we go above the temperate coniferous zone. It has been seen that the 'Alpine Fir-Birch Forest' zone as defined by Champion (1936, p. 269) is the uppermost limit in the Himalayan region, beyond which there is a sharp transition of flora with rhododendron shrubs predominating. This transition obviously corresponds to the different biotic environments met with in the two zones. Champion's 'Alpine Fir-Birch Forest' zone may, therefore, be taken as the lowest limit of high altitude as a biotic environment. The limit of the alpine fir-birch zone varies from west to east, being about 3,000 meters (*ca.* 9,840 ft.) in the western Himalaya, and 3,800 m. (*ca.* 12,500 ft.) in the eastern.

It is apparent that the physical elevation alone does not give rise to high altitude conditions. Furthermore, it is apparent that the limit differs widely according to the local conditions of geographical position and direction of the mountain ranges, moisture-content of the air, velocity of the wind, ice formation, avalanches, landslides, solifluction, composition of soil, etc. (Griggs, 1946). Thus, in the Rocky Mountains, Washington, the tree-line is about 3,300 m. (*ca.* 10,800 ft.), while on different slopes of Mount Washington, New Hampshire, it varies between 1,200 and 1,740 m. (*ca.* 3,900 and 5,700 ft.), and at Bay of Islands, Newfoundland, it is only 300 m. or about 980 ft. (Clarke, 1954)! Likewise, there is indeed a sharp difference in the altitudinal figures for tree-lines on the northern and southern faces of the Himalayas.

## ZOOLOGICAL PROBLEMS

In an area as interesting as high altitudes of the Himalayas, the animal and plant lives should also be highly interesting, since they tend to pose a number of important biological problems of a fundamental nature. But, unfortunately, we know so little about the animals of high altitudes that we are unable to make any headway. Not very long ago the ounce or snow leopard (*Panthera uncia*) used to roam about the high Himalayas in fair numbers, but it is rather scarce now—so much so that it has been included in the list of protected Indian animals (prohibited for shooting and export). It follows, therefore, that proper measures ought to be taken soon to prevent its extinction. But, so little is known about the ounce — its status, its life, its habits and habitats — that no effective measures, however genuine, seem possible immediately for its preservation. India has a substantial trade in fur of high altitude animals, but the possibilities of expanding the trade by scientifically rearing these animals cannot be explored, because nothing very much is known about them.

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[1] See *JBNHS*, 51: 530 (1953).

We are better acquainted with game mammals and game birds of the high altitudes because of their value as sport, but nothing is known about the adaptive adjustments that have enabled them to flourish under such highly specialized conditions.

It would then appear that there are a number of zoological problems associated with high altitudes of the Himalayas, which require our urgent attention. The more important ones are briefly discussed below. It is, however, necessary to state that most of these problems are so interlinked that they are grouped together under certain general captions.

## FAUNAL STUDIES

Faunal studies are the first prerequisite for any type of detailed zoological researches. Although a number of Expeditions (mostly political !) made collections of animals at high altitude areas of the Himalayas, no systematic faunistic survey has as yet been conducted there. A thorough survey of animal life of the high altitude area demands, therefore, our first and foremost attention. Faunal studies may be conducted roughly along the following lines :

Systematics and Zoogeography: Studies on systematics of animals and zoogeography should provide faunal lists of the various groups of animals, a knowledge of their horizontal and vertical distribution, the proportion of palaearctic and oriental elements, and other relevant topics.

Ecology: A study of the physico-chemical and biotic elements of environments and their effects on animal life is also in demand.

These investigations are likely to be of far-reaching consequence in understanding the process of organic evolution. They may also throw light upon many palaeogeographic problems, so little understood at present, and on the spread of pests and diseases.

## BIONOMICS OF ANIMALS

High altitudes present certain specific environmental conditions that require special adaptations. Limited amount of vegetation, extreme temperature condition, strong wind, freakish weather, low oxygen- and moisture-content of the air would normally make it difficult for animal life to survive and flourish under such conditions. In spite of this, it is amazing that the Himalayas support a great variety of fauna in the higher domains. How these animals live, breed and flourish there is indeed one of the most fascinating problems.

Studies of the life-histories of different animals — their modes of reproduction, various stages of development and growth — all involve observations both in the field and in the laboratory throughout the year. Furthermore, various physiological processes, such as respiration, circulation, digestion and metabolism, and food and breeding habits, call for extensive studies, experimental and otherwise.

Severe weather conditions of high altitudes are either resisted or escaped by animals through migration to more favourable areas, or they induce a spell of dormancy. These phenomena may be studied under the following heads:

Hibernation: This state of dormancy is so far known to be brought about by gradually decreasing temperature, inadequacy of heat regulating mechanisms, shortage of food, dryness of food, concentration of carbon dioxide in the hibernacula, accumulation of fat, glandular disturbances, etc. Though some work on the hibernation of some animals has been done in Europe and America, it is not known how far the factors mentioned above induce hibernation under the prevalent Himalayan conditions.

Aestivation: This is another state of dormancy, but is brought about by drought instead of by low temperature. With the increase in altitude, there is an increase in the rate of evaporation, thereby causing loss of water-content leading to aestivation. The question of aestivation has, therefore, a direct bearing on the water-relation of animals.

Overwintering: This involves passing through severe winter conditions. So far as is known, animals resist the cold of winter by the development of protective covering, by decreasing physical and metabolic activities, by developing cold-hardiness, or by a combination of some or all of these measures. Although the phenomenon of overwintering has been known in insects as well as in vertebrates occurring in other parts of the world, it is as yet unknown for the Himalayan animals.

Migration: The escape from severe weather conditions involves an orderly movement of animals. In some groups, such as birds, this takes place on a geographic scale, that is, they migrate from one country, even from one continent, to another. In certain other groups, such as insects, geographic migration is rather rare. In typical cases, it may be noted, the migrated animals return to their original homes when conditions become favourable.

## PARASITOLOGICAL STUDIES

The incidence of parasitism among animals dwelling at high altitudes is very little known. There is a large scope for investigation of ectoparasites and endoparasites of animals living in this zone, especially of the warm-blooded vertebrates. Studies on the seasonal fluctuation in the frequency of parasitic infection, though known for some of the parasites at lower altitudes, have not been conducted for high altitude areas. The usefulness of such studies in relation to human and animal diseases is obvious and need not be underlined.

## Study of Variations

It is a well-known fact that no two individuals of the same species look exactly alike. This is due to the biological fact of variation. The study of variations is one of the most important aspects of evolutionary biology, and is one of the main pivots on which the process of organic evolution, as understood today, turns.

Variations are of two types, phenotypic and genotypic, the essential difference between the two being that the latter is heritable though not always perceptible, while the former is detectable but may not be heritable.

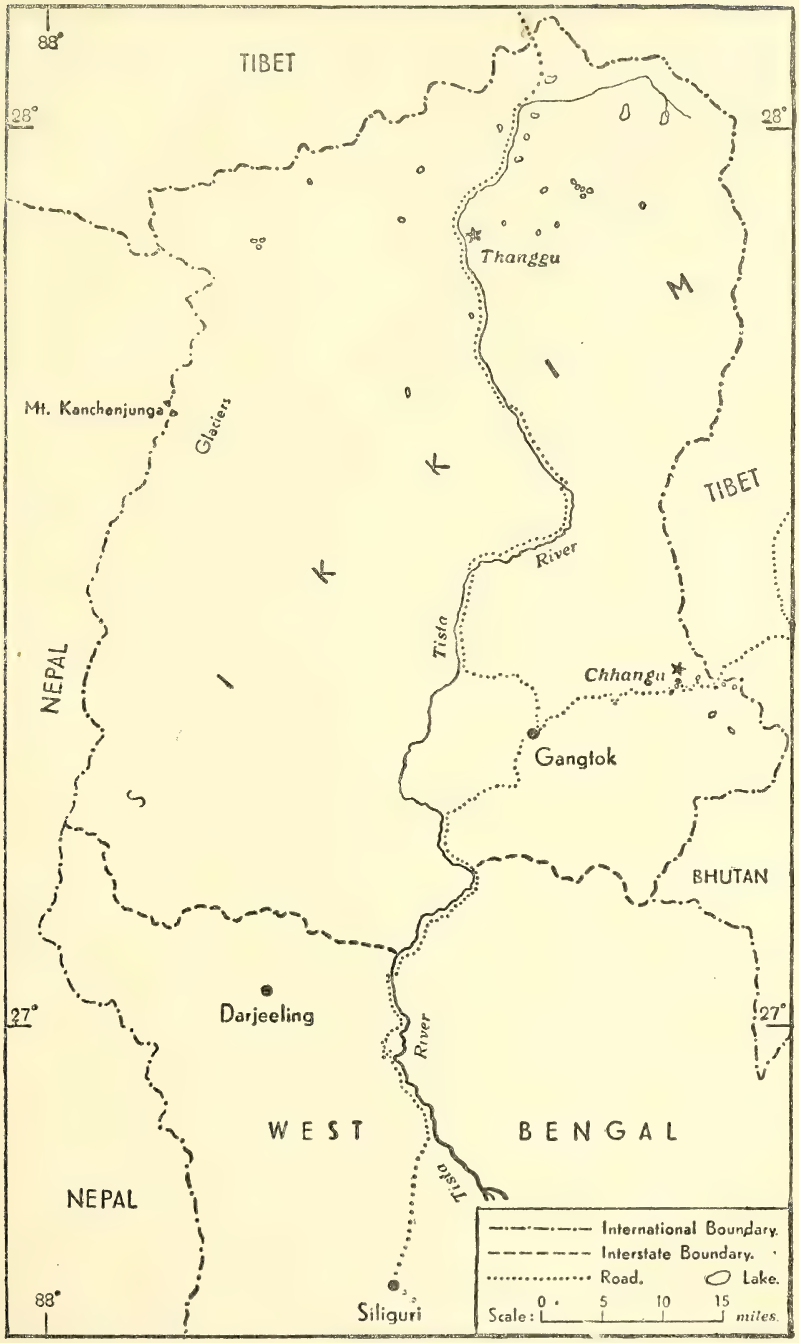
Low temperature is known to bring about certain interesting variations in animals, two of which are mentioned below:

Cyclomorphism: This is the phenomenon of phenotypic changes in structure brought about by change in the season. Such structural changes are usually transitory and reversible, and the animals regain their original structure on the return of normal season. The phenomenon has been observed in certain crustaceans, and is believed to be caused largely by low temperature. It is, however, likely that some other factors, unknown at present, may have contributory rôles in producing cyclomorphism.

Jordan's Rule: This is the relationship between the temperature and the number of vertebrae in closely related species of fishes. Fishes of colder waters tend to have more vertebrae than those occurring in warmer waters. This phenomenon is an instance of genotypic variation. Although verified for different latitudes, one does not know to what extent Jordan's Rule is applicable to fishes residing in higher altitudes where water is sufficiently cold. This principle may be of use to fishery biologists in ascertaining the origin of populations among the species of fish that exhibit this phenomenon. It is also worthwhile examining how far this phenomenon is applicable to other groups of vertebrates.

## Concluding Remarks

It will have been noted from what is detailed above that the high altitudes of the Himalayas have received less than their merited share of attention, although they are pregnant with possibilites for some outstanding zoological researches of a fundamental nature. There is no gainsaying the fact that the bearing of such researches on man is far reaching. Studies of the adaptation of animals to extremely low temperature, low atmospheric pressure, low oxygen-content of the atmosphere, limited food supply (qualitative and quantitative), high


88°
TIBET
28°
28°
Thanggu
Mt. Kanchenjunga
Glaciers
S I K K I M
TIBET
River
Tista
NEPAL
Chhangu
Gangtok
BHUTAN
Darjeeling
27°
27°
River
WEST BENGAL
Tista
NEPAL
88°
Siliguri
International Boundary.
Interstate Boundary.
Road.
Lake.
Scale: 0 5 10 15 miles.

Map 1.—Part of the eastern Himalayas showing the suggested locations* of the High Altitude Biological Research Stations.

rate of evaporation, high light intensity, high ultraviolet radiation, etc. are of paramount importance in understanding human reactions to similar environments, which are helpful not only in war but also in peace.

In a country like India where the whole of the northern frontier is bounded by the Himalayan ranges for some 1,200 miles, high altitude areas may be found anywhere along this length. In spite of this rich, varied and vast field, there has never been any organized attempt to study the fauna or animal life of these areas. The establishment of an institute for such studies seems imperative, and will certainly prove worthwhile. With increased attention to the biological sciences during the Second Five-Year Plan period, the establishment of a High Altitude Biological Research Institute will be quite in keeping with the march of time.

The institute should be located either in the eastern Himalaya or in the western, the central portion that lies between Garhwal and the Sun Kosi Valley (this is, however, outside the Indian territory) not being particularly suitable, because the majority of vertebrates, and possibly many invertebrates, of this area are 'intergrades' between the eastern and western Himalayan forms.

Accessibility and safety, in addition to high altitude, are the obvious requirements for a good site. From this point of view Thanggu in North Sikkim appears to be an ideal place for the institute (see map). It is situated in the Tista Valley at 13,000 ft., that is, about the tree-limit, and only five marches from Gangtok, from where it can be reached by foot or pony. Gangtok may also be easily contacted in emergency through wireless from Chungthang, two marches below Thanggu. Incidentally, it may be mentioned that the Indian Council of Scientific and Industrial Research, in their proposal to establish a High Altitude Research Station, had this place in view. There may also be a station at Chhangu (*ca.* 13,000 ft.) in East Sikkim (see map), on the main Indo-Tibetan Trade Route (one of the Indian National Highways), about two days' march from Gangtok, but which may now be reached by jeep. Gangtok itself is connected with the railhead at Siliguri, some seventy miles away, by a regular bus service. Both Thanggu and Chhangu offer reasonable access to glaciers, lakes and scrub forests at fairly high altitudes without demanding special mountaineering skill or imposing undue hazards. Accommodation and catering at both these places are, however, difficult. The State Rest Houses there are small and unsuitable for permanent laboratory purposes. Suitable accommodation for laboratory and residential purposes would have to be built when the institute is set up. Food supplies may be easily arranged from Gangtok.

## ACKNOWLEDGMENTS

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# NOTES ON THE BAYA WEAVER BIRD, *PLOCEUS PHILIPPINUS* LINN.

BY

SÁLIM ALI AND VIJAYKUMAR C. AMBEDKAR

(*With a plate*)

## INTRODUCTION

During the past three breeding seasons of the Baya (June/July to September/October 1953-1955), we have kept several nest colonies under fairly close observation and study in the environs of Poona City (Bombay State). The present is merely an interim report of some of our findings, and is published in the hope that other bird students with suitable opportunities for observation and experiment may be enabled to contribute to the meagre knowledge we possess concerning the life history of this common and interesting bird, and allied species of Indian Ploceinae. The field work has been carried out chiefly by V.C.A., a resident of Poona, under the advice and direction, and with the intermittent participation of the senior author.

A broad outline of the breeding biology of the Baya was originally published by Sálim Ali in 1931 (*JBNHS*, **34**: 947-64). A large amount of confirmatory evidence has accumulated since, and it now seems reasonable to consider the basic pattern as established. However, many fundamental facts regarding the life and movements of the Baya in the non-breeding season, and precise statistical data relating to its nesting behaviour were, and still are, completely lacking, and the object of our investigations has been to collect as much further detailed information as practicable.

One of our major handicaps so far has been the impossibility of studying the same colony uninterruptedly from the commencement of the breeding season right through to the end. The most populous and easily controlled colonies in the Poona area are usually those built around irrigation wells situated within the various 'wādis' or market gardens. Owing to the damage bayas do to the surrounding bajra and jowar crops, the farmers are in the habit of pulling down all accessible nests from time to time. These holocausts usually take place just when a colony is at the peak of activity, namely when the majority of the eggs have hatched. It is disconcerting to find one's observations suddenly broken off thus, often at the most crucial stage. We have been compelled, on this account, to divide our attention between several widely scattered colonies, and to piece together bits of data collected as opportunity offered.

Another difficulty which has seriously hampered our work and prevented the procurement of unequivocal data concerning individual birds in a breeding colony is the want of a workmanlike technique for marking nesting bayas without catching them and thereby possibly upsetting their normal behaviour patterns. Yet for statistical precision it is obviously essential that individual birds in a colony, at least the control ones, should be unmistakably identifiable.

Squirting liquid dyes on to the bird with a water pistol was unsuccessful, since the jet, apart from being too thick and conspicuous, was not of sufficient velocity to reach the bird before it could move away. Latterly we have used a large hypodermic syringe, such as is employed for inoculating cattle, which, discharged from within an observation hide at the range of a few feet, has given better promise. The jet is finer and more powerful, carries a longer distance without spreading out too much, and its trajectory can be controlled. The larger capacity of the barrel enables the aim to be corrected while the jet is in action, without alarming the bird unduly.

In squirting liquid dyes the object is to mark a bird while it is clinging to its nest, so that both bird and nest get sprayed simultaneously, making them thereafter readily recognizable as belonging to each other. It is only by marking in this manner that the social behaviour and inter-relationships of individuals within a colony can be satisfactorily studied. The aniline dyes used in the 1954-55 experiments were crimson, green, yellow and blue. We are grateful to the German dye manufacturing firm of Cheka Ltd. of Bombay, for their interest in the problem, and for their valuable advice and generous co-operation.

Marking Bayas.

During the breeding season, when recognition of individuals within a colony is of the utmost consequence, it is not easy to devise a technique that will enable catching of the birds at the colony without disturbing their normal behaviour and rhythm. For males, the only feasible method seems to be to spray them with quick-drying liquid dyes, fast to rain and sun, which will identify them at least until the post-nuptial moult; therefore, throughout one complete nesting season. But it is also desirable that the males should be marked in some more permanent manner so that their migratory local movements and their inter-flock behaviour during the off season, and their colony-forming and sexual activities on the approach of the next breeding season can be properly studied. For catching the males at a colony for ringing, we have as yet found no practicable method.

However, accidentally we hit upon a successful method of catching nesting females for marking with dyes as well as with coloured and aluminium rings. While incubating, and for the first 6 days or so after the eggs hatch, the female sleeps in the nest at night. The slightest jerk to the nest after dark causes her to slip down the entrance tube and make off in a flash. We found that a butterfly net held quietly over the mouth of the tube, before the nest is touched, secures the escaping female without difficulty. In the same way it it possible to secure, during daytime, full-fledged young that try to escape from the nest prematurely on its being handled.

How and why a particular tree, or group of trees, is initially selected from amongst others which to all appearances are equally suitable, is a moot point. Once a nest colony has been established, however, there is no doubt that the old nests, or their battered remnants, serve to attract the birds in successive seasons. We know colony sites that have been in yearly occupation for at least 30 years, and they doubtless continue longer under the requisite conditions. Even after the periodical wholesale destruction of the colonies by the local farmers, the birds resort to their traditional nesting sites year after year. Whether, and to what extent, the members of one particular colony return to the same spot in successive years, and to what extent, if at all, the young return to their birthplace for nesting, in what manner and on what pattern dispersal of the young occurs, whether some males and some females (or all females?) breed in their first year, and the factors that alter the sex ratio by the time the birds become adult, are some of the points which challenge investigation.

One striking feature about the colonies is the definite limit to which an individual colony seems capable of expanding. The number of nests in a colony remains more or less constant from year to year so that there is apparently some factor or factors that govern annual fluctuation of numbers, and also control expansion above an optimal upper limit. That some colonies are larger than others is, as far as can be observed, not due to progressive annual growth: thus a colony containing, say, 60 completed nests will hold approximately the same number year after year. Small colonies are more apt to be abandoned (i.e., they are of a more 'shifting' nature) than large, old-established ones which presumably began as large colonies in the first instance.

From the data collected it appears that, although a few isolated females become physiologically mature and begin laying in some of the earliest nests, the majority of females arrive much later, at all the scattered colonies in the area more or less simultaneously, in search of eligible nests. They come, as it were, in a great wave or irruption, all in a matter of a couple of days. The exact period of such irruption, in a normal monsoon, is between the latter part of July and the third week of August, as soon as the weather breaks after several days of heavy and continuous downpour. During such wet spells there is a lull in the building operations of the males, to be followed by a spurt of intense activity immediately drier weather intervenes. Accompanying these feverish building activities is a good deal of excited flapping and fluttering of wings, and loud lively choruses which can be heard over enormous distances in the countryside, and which no doubt serve to orientate the prospecting females. Thus the larger colonies, by virtue of their louder vocal advertising, have an advantage over the smaller and less noisy ones. It would, therefore, be of advantage for smaller colonies to be built close to large ones, and this, in fact, is very often the case.

The arrival of sexually mature females *en masse* ensures the virtual synchronization of laying and hatching. The chicks also leave the nests more or less simultaneously—perhaps within the span of a week or so. The colony, thereafter, becomes silent and deserted except for an odd belated nest or two in which the females alone continue to feed the young. These foraging females are now very shy and circumspect, usually flying up rather surreptitiously straight into the nest, and away, with no tell-tale loitering. The change in their behaviour is due, no doubt, to the removal of the collective vigilance of the colony.

Apparently the flock instinct is so strong that in a few nests in almost every large colony one may actually find an entire clutch of partly incubated eggs, or even a mummified brood of nestlings which have been abandoned to their fate by the parents in their hurry to leave the colony with the rest of the birds. The frequency with which such abandoned nests are found at the tail end of the season, particularly in the larger colonies, leaves little doubt as to the circumstances.

The peak period of the nesting activities synchronizes with the progressive ripening of the adjacent jowari crops upon which the adults and freshly launched young so largely subsist, and to which they cause such considerable damage.

In the earlier stages of a colony, before the main body of prospecting females arrives ('pre-irruption' period) there is naturally much greater competition and rivalry among the individual males for winning the few hens that are ready to nest. The felonious practice of cutting down the nests of rival cocks, while the owner has gone to fetch building material, is much more in evidence during the earlier stages of nesting than after most males have secured mates and are occupied in further building. Whether the early breeding females are double brooded, i.e., whether they raise a second family during the same season, remains to be shown.

Eggs are laid at 24-hour intervals, in the early morning. Incubation apparently starts from the second egg, and takes 14-15 days. Full-fledged young leave the nest 13-14 days after hatching. The female occasionally feeds them outside at first, but they mostly fend for themselves.

### Sex Ratio.

The sex ratio of adults in the colonies is found to be invariably 2 females (occasionally 3) to 1 male. This has been ascertained by repeated counts and rechecking of completed, occupied nests, and of the working males.

A normal brood in the Poona area consists of 3 or 4 young. It is desirable, therefore, to determine whether this disparity in the sexes is present from the time of hatching, or comes about at a later stage possibly due to some mortality factor selective against the males. We hope to devote special attention to this problem during the 1956 season.

### Abnormal Nests:

Abnormality in the structure of baya nests takes a variety of forms. The commonest and most frequent one is the double or 'tandem' which consists of one nest suspended from the end of the entrance tube of a completed upper nest. Occasionally it may be a 3-storeyed affair with the middle nest in different stages of completion. Two adjacent nests are sometimes conjoined exteriorly by a woven fabric, and in other ways. Some types of abnormal nests are shown in the plate. In all examples of double or triple nests, we found only a single chamber—the last built—to be in current use, the others being blocked

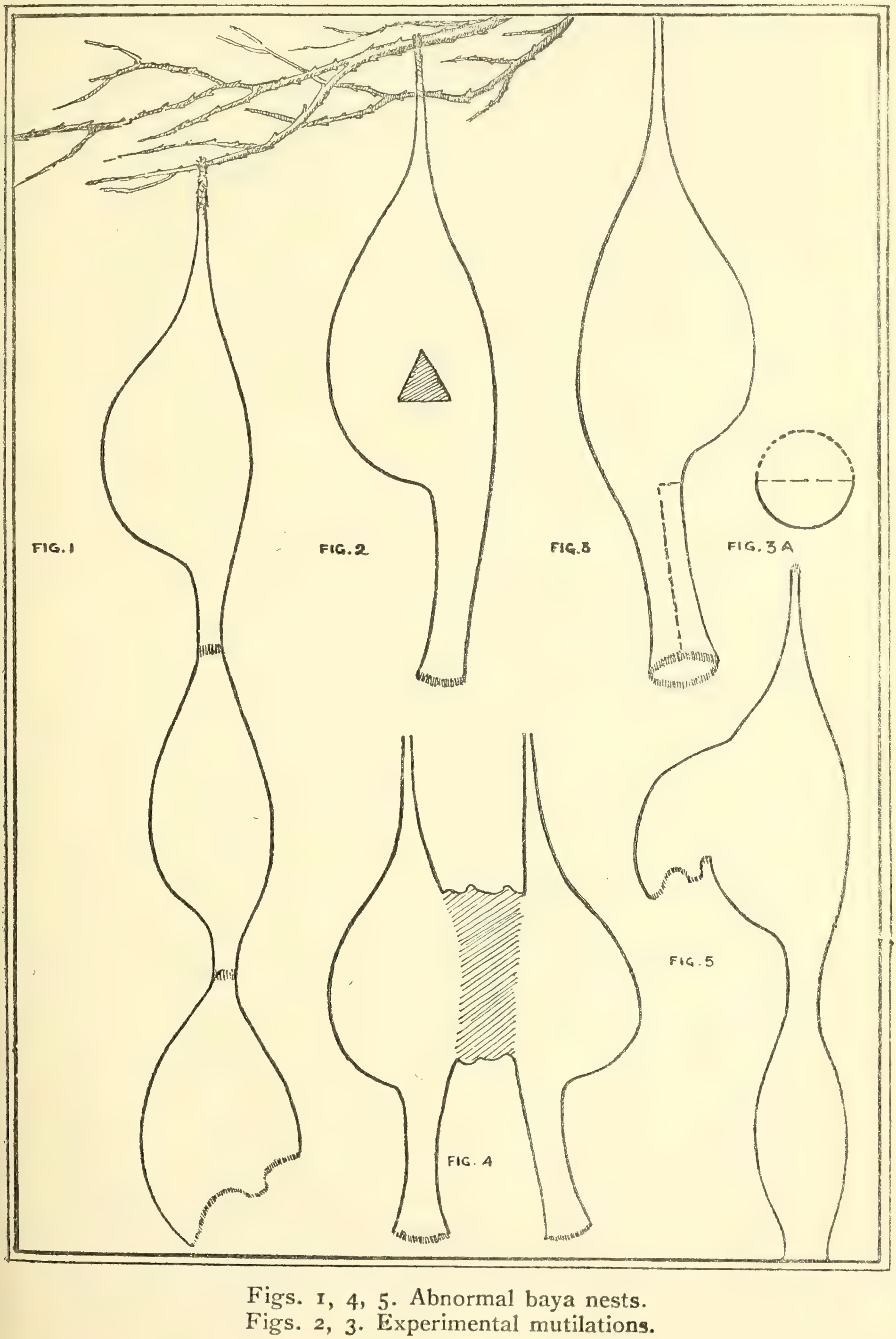
FIG. 1
FIG. 2
FIG. 3
FIG. 3 A
FIG. 4
FIG. 5

Figs. 1, 4, 5. Abnormal baya nests.
Figs. 2, 3. Experimental mutilations.

up and unoccupied. In most cases, however, the lowest nest remained unfinished. We have found no suggestion that such multiple nests were ever intended for contemporaneous habitation, e.g., by a 'harem', or that it may be an experiment in 'apartment housing'—the rudimentary beginnings of a composite community-nest as in the Sociable Weaver (*Philetairus socius*) of Africa.

In all the closed-up and sealed-off chambers of the multiple nests examined by us, there has invariably been evidence of some disaster to the contents. Such evidence usually consisted of dried matted yolk or cracked eggs—the result of some accident or felony(?). In one case a desiccated chick, perhaps 5 days old, was found partially but deliberately buried (woven over) in the fabric of the lining of the egg chamber, as the damaged contents usually are.

It seems obvious that the hyperstructures to a normal nest are added by the original builder himself. But whether the second chamber, if occupied, is by the original female or a different one, needs to be determined. When two completed, occupied nests hanging side by side are conjoined into one unit, it is definite proof that they both belong to one and the same individual, since no cock baya will tolerate a neighbour or stranger tampering with his property.

As a result of our observations it can unreservedly be stated that W. Jesse's account (*Ibis* 1897, p. 558) of a 7-storeyed nest is inaccurate, especially in regard to the storeys being added year after year. The last 3 chambers in this nest are said to have contained 3, 3 and 2 eggs respectively. If this is to suggest that these chambers were in contemporaneous occupation by 3 different females — e.g., in the nature of an apartment house or a 'block of flats' — then the statement is open to serious doubt. Baya nests are strictly annual structures; they are built afresh each season, the remnants of the previous year's nests being torn down to make room for the new ones. We have not found any evidence that the same nest is ever used in a second season.

V.C.A. recorded one double-storeyed nest in which the sealed-off upper chamber contained 4 *fresh* and apparently undamaged eggs, while the lower chamber was at the early 'pre-bell' or 'helmet' stage. In this case it is conceivable that the female concerned had, for some reason, deserted the nest (maybe killed?). And since cock bayas do not incubate, the owner commenced adding the lower nest in order to attract another hen. When the eggs in a nest get accidentally broken the hen naturally deserts the nest, whereupon the male seals it off and often adds a lower chamber. In the above case, since the eggs were undamaged, the female may have failed to turn up for a different reason.

### Intelligence.

In earlier field work, in order to inspect the contents of controlled nests in a colony, S.A. had cut a vertical incision in the woven fabric opposite the egg chamber. On visiting the colony again on the following day he had observed the incision to be neatly darned with fresh green strips of grass, producing the appearance of a zip fastener. Repairing such incisions in this clever manner is so foreign to what the bird would ever be called upon to deal with under natural conditions, that the behaviour suggested something higher than a purely instinctive reflex. At the suggestion of Prof. Bernhard Rensch of Münster we therefore planned a series of experiments to test the extent of the baya's capacity to deal with unaccustomed and unnatural situations. Windows of various shapes and sizes—round, oval, square, rectangular, triangular etc.—between 1 and 2 inches across, were cleanly cut out with a pair of scissors in the walls opposite the egg chamber of selected nests. Only nests containing chicks were used for these experiments in order to minimize possible desertions. The windows were usually cut in the forenoon while the female was away foraging. On return with food for the young, the usual reaction of the hen to this sudden transformation in her abode was, curiously enough, one that can only be described as indifference; there was certainly no perturbation on her part, though sometimes she did seem mildly puzzled.

In one instance the hen flew up the entrance tube of her nest, as usual, and fed the chicks apparently before she realized that there was anything amiss. After feeding, she poked her head out of the newly erupted window, looked surprisedly this way and that, and actually made her exit through the opening. She clung to the nest above the window, head downward, peering within through the opening repeatedly, and 'nibbling' at the jagged edges. The bird then flew off but returned 5 minutes later, again clung outside the nest, peered into it repeatedly, and tugged undecidedly at the loose ends. She then hopped across to a neighbouring half-built nest, but made no attempt to pull out any strips from it for the repair; she then hopped back on to her own nest behaving in the earlier inane fashion for another 5 minutes or so. She flew off once more and returned 20 minutes later with a soft white contour feather of some bird in her bill. Employing the same technique as she would in lining the egg chamber, she attempted ineffectively to block the hole by pressing the feather on the jagged rim. After this token repair the bird flew off. She returned 10 minutes later with food for the chicks. Instead of flying up the entrance tube, she now clung to the outside of the nest and, in quite a matter-of-fact manner, passed the food to the chicks through the window, like a flowerpecker!

Thereafter she removed the feather from where it had been pressed in, and tried refixing it at several different points. It was quite obvious that not being familiar with the weaving technique she was completely at a loss about how to set about repairing the damage.

During all this interval the cock was nowhere to be seen. One cock, perched on a bush 3 ft. away, seemed completely unconcerned and presumably was not the owner of this nest.

In the above case, as in the many others experimented with, the damage was found fully repaired when the nest was visited again about 9 o'clock next morning, although usually by sundown the previous evening there had been no sign of activity from the cocks in this regard.

In a second nest, containing 3 well-grown young, a triangular window was cut with 1½" base and 2½" sides (fig. 2). When revisited at 10 next morning there was a flimsy woven criss-cross triangular mat of green grass strips covering the hole, fixed to the nest along two sides of the triangular window, but loosely flapping along the third side. The mat looked as though it had been prepared separately and then fixed *in situ* ! The repair was uncompleted.

Square, rectangular and oblong windows were all darned over with equal speed and skill, suggesting a degree of true intelligence quite above what is ordinarily conceded to the average bird.

In one nest the entire entrance tube was snipped off from its base, at the level of the egg-chamber. By 10 o'clock the following morning, 3 inches of the tube, in the form of a collar, had been rebuilt with fresh green grass strips. All fresh repairs stand out prominently, even at a distance, by contrast with the yellowish brown colour the nest has acquired after many days of exposure to the sun.

The cleverest repair, in our opinion, was where the entrance tube had been transversely bisected or slit all along its length leaving merely a vertical channel on one side (fig. 3). By next morning the mutilation had been repaired by the addition of the complementary half channel, thus restoring the original circular tube. The speed and neatness with which this intricate repair was executed, and the precision with which the new half was curved and channelled were quite remarkable.

All repairs, in every case, were made entirely by the cocks who normally started serious work on them soon after daybreak on the following morning. On one or two occasions we found a few strips of the darning already in position the same evening before the males left for their nightly roosts.

In one case the hen flew up the tube with food for the chicks as usual, but promptly went out through the round window again, flying up the tube a second time and repeating the window exit, as if trying to believe her eyes ! But later, through the rest of that afternoon, she freely used the window for her exits after feeding the young. The cock, who was actively employed on a second nest near-by which a second hen was prospecting, paid no attention to repairing the damage despite the fact that from time to time he alighted on the mutilated nest and had obviously realized that repair was necessary. By noon on the following day, however, he had completely repaired the hole. To observe further reaction, this repaired patch was excised a second time leaving the round open window as before. The cock visited the nest several times thereafter, but did not commence repair work till 75 minutes later, bringing fresh green grass strips as his darning thread. The repair work was fitful since the cock's attention was diverted by the new hen of his second nest whose frequent comings and goings caused him to leave off and give amorous chase. It was clear that just then he was more concerned about the new hen than about repairing his damaged first nest. In spite of the interruptions, however, the repair was fully completed in 2 hours after commencement.

V.C.A. has recorded that when he excised the newly repaired patch he left the round wad of woven strips lying on the ground below the nest. He was surprised to see that, after completing the repair the second time, the cock picked up this wad and attempted to utilize it as such on the second nest which was as yet unfinished. He tried to fix the wad into this place and that, but finally jettisoned it !

Next morning, the entire entrance tube —7″ in length— of this twice-repaired nest was amputated, exposing the 'cross-bar' which forms the rim of the egg chamber in the completed nest. The visiting hen was completely unperturbed by this sudden and unexpected transformation in her dwelling and showed no hesitation in flying up to the nest, settling on the now-exposed cross bar, and feeding the young. She thereafter flew off with the chicks' excreta in her bill as usual. The male looked more surprised. He accompanied the hen to the nest 3 times when she brought food, and then visited it by himself several times. He sat about on the nest, and laconically examined the damage, once tapping on the portion he had repaired the previous day. The first fresh material for replacement of the tube was brought 30 minutes after the amputation. Work was slow and frequently interrupted, as yesterday, by the claims of the second nest and female. Seven hours after the repair work commenced, a firm foundation of the new tube had been laid, and a fresh green collar 1½″ broad marked its progress. This collar had broadened to 2½″ when the nest was visited the following afternoon, and no further extension of the tube was made thereafter.

Between the third day after hatching and the fifth, while the cock was busy with the repairs, he had remained indifferent to the begging of the young for food each time he arrived at the nest, and had gone right ahead with the work in hand. He fed the young for the first time when they were 6-7 days, and only after he had finished his second nest and completed repairing the first. Once started, he continued to feed the chicks regularly thereafter, and even more assiduously than the hen, e.g., 6 times in 24 minutes as against the hen's once. From the sixth night after hatching, it was observed that the hen did not sleep in the nest with the 3 well-grown young, presumably owing to pressure of space.

When a large hole was cut once again in the same much-repaired nest after the young were 6 days old and the male had commenced feeding them, he paid no attention to repairing the damage any more, and even made a convenience of it, for feeding the young through the opening and for his entries and exits. One full-fledged young left this nest on the 13th day; the other 2 on the 14th day after hatching.

### Enemies and Mortality.

On one occasion V.C.A. found a brood of naked young of the Long-tailed Tree Mouse (*Vendeluria oleracea*), together with a parent, within the upper storey of a double nest. A passage had been bored through the ceiling of the lower half-built ('bell') nest for entering the tube leading to the upper chamber. One of these mice was found in another nest also. This nest was empty then, though when examined a few days earlier it had contained baya eggs. The nest was later taken possession of by a pair of Whitethroated Munia (*Uroloncha malabarica*) and in time held 6 eggs. When inspected again the next day the eggs had vanished and in their place was their presumptive despoiler. Circumstantial evidence suggests, therefore, that this mouse may be responsible for some of the mortality among bayas in the Poona area.

On 20 September, i.e., near the close of the nesting season, when most colonies in the Poona area held young of various ages, one fairly populous colony was found to have most of its nests bored with circular holes of *ca.* 1″ diameter opposite the egg chamber (above the base of the entrance tube). The contents had been rifled. The predator was undetermined, but from the presence of a halo-like depression around the holes, it was evident that the culprit was some large bird like a crow or coucal whose breast had dented the fabric while it forced its head through the holes to reach the contents.

But the heaviest mortality certainly results from the widely prevalent practice of farmers of pulling down baya nests *en masse* and thus devastating entire colonies at the time when they contain helpless young or hard-set eggs. These pogroms take place when the season is well advanced so that there is no possibility of a second brood. Entire colonies are wiped out, the nests being torn down and the nestlings often left to starve to death. Many flightless fledglings wander away from the ravished nests, hopping on the ground or clambering amongst the undergrowth, and soon fall a prey to mongooses, cats, crows and other predators.

Under the circumstances only isolated nests or small colonies high up in trees and out of easy reach have a chance of survival. Crowded colonies scattered amongst the fields, in and around irrigation wells, are especially vulnerable. There is no denying that bayas are highly destructive to ripening jowar and bajra crops, and were it not for this ruthless control by humans, the species could possibly become a major pest of local agriculture as some of its close relations in Africa are known to be.

# SOME OBSERVATIONS ON THE TROUT FARM AND HATCHERY AT ACHHABAL, KASHMIR

BY

SUNDER LAL HORA (DECEASED)

The Trout Farm and Hatchery at Achhabal were started in 1906-1907 and adjoin the Mogul Gardens. They are thus a great attraction for thousands of visitors and tourists. Unlike two other trout farms and hatcheries at Harwan and Laribal, the water supply at Achhabal is from a flowing spring directly to the farm without any protective works. No precaution is thus taken to prevent trash and debris from being carried into the water supply line. Though normally the water is only slightly turbid, at times it becomes muddy also. The observations recorded here were made during two short stays at the farm during June 1954 and July 1955. I am grateful to the authorities for supplying the data and to Mr. G. M. Malik, Director, Fish Preservation Department, Jammu and Kashmir State, for going through the article and offering comments.

## STOCK POSITION

Both Rainbow and Brown trout are kept at the farm of sizes varying from 2 oz. to 5 lbs. The stock position during the last six years was as follows:

| Year | | 1949–50 | 1950–51 | 1951–52 | 1952–53 | 1953–54 | 1954–55 |
|---|---|---|---|---|---|---|---|
| Rainbow | ... | 485 | 586 | 509 | 442 | 398 | 410 |
| Brown | ... | 2,552 | 2,520 | 2,252 | 2,227 | 1,958 | 1,907 |
| Total | ... | 3,037 | 3,106 | 2,761 | 2,669 | 2,356 | 2,317 |

The quantities of trout sold from this hatchery for the same period are given below:

| Year | | 1949–50 | 1950–51 | 1951–52 | 1952–53 | 1955–54 | 1954–55 |
|---|---|---|---|---|---|---|---|
| Rainbow | ... | 4 | 5 | 10 | 3 | 5 | 14 |
| Brown | ... | 94 | 161 | 165 | 202 | 109 | 119 |
| Total | ... | 98 | 166 | 175 | 205 | 114 | 133 |

| Year | | 1949–50 | 1950–51 | 1951–52 | 1952–53 | 1953–54 | 1954–55 |
|---|---|---|---|---|---|---|---|
| Weight | ... | 484 lb. 14 oz. | 795 lb. 9 oz. | 844 lb. 8 oz. | 836 lb. 12 oz. | 415 lb. 7 oz. | 487 lb. 4 oz. |
| Amount realised. | Rs. | 749-7-3 | 1,278-3-3 | 1,302-4-3 | 1,521-8-0 | 964-14-6 | 1,507-8-0 |

The quantity of diseased fish of different sizes that had to be destroyed during the same period was as follows:

| Year | | 1949-50 | 1950-51 | 1951-52 | 1952-53 | 1953-54 | 1954-55 |
|---|---|---|---|---|---|---|---|
| Rainbow | ... | 53 | 94 | 67 | 64 | 59 | 72 |
| Brown | ... | 294 | 171 | 272 | 223 | 188 | 179 |
| Total | ... | 347 | 265 | 339 | 287 | 247 | 251 |

Calculating the mortality figures against the stocks in the corresponding years we get the following percentage of mortality for each kind:

| Year | | 1949-50 | 1950-51 | 1951-52 | 1952-53 | 1953-54 | 1954-55 |
|---|---|---|---|---|---|---|---|
| Rainbow | ... | 11.0 | 16.0 | 13.1 | 14.5 | 15.0 | 17.5 |
| Brown | ... | 11.5 | 6.7 | 12.0 | 10.0 | 9.6 | 9.4 |

It will be seen from the above statement that the rate of mortality is generally higher in the case of Rainbow than that of Brown trout.

Besides the sale of trout, which is insignificant, the main function of this hatchery seems to be the stocking of trout streams with eyed ova and fingerlings. The figures in this respect for the last 6 years are as follows:

| Year | | 1949-50 | 1950-51 | 1951-52 | 1952-53 | 1953-54 | 1954-55 |
|---|---|---|---|---|---|---|---|
| Eyed Ova | ... | 1,50,000 | 1,50,000 | 1,50,000 | 1,00,000 | 2,50,000 | 1,95,000 |
| Fingerlings | ... | 3,237 | 3,310 | 1,328 | 4,177 | 2,340 | 3,500 |

In 1954-55, a total number of 481,000 eggs were obtained. Of this number, 247,000 became 'eyed', while the others had to be thrown away, thus showing a survival 51·3%. This survival rate seems to be good when it is learned that old antiquated hatchery methods are followed. The eggs once laid in trays are not touched and even the dead eggs are not picked and removed out, thus allowing fungus to take a full toll of the healthy eggs.[1]

In 1954-55, 72,000 eyed ova were retained in the hatchery for cultural purposes and the fingerlings developed out of them will be counted at the time of next breeding season.

## Diseases and other Causes of Mortality

In 1939, Malik[2] reported on an epidemic among Rainbow trout in the Harwan Hatchery during 1934 and also made some observations on certain other cases of mortality in that hatchery. He attributed the epidemic to lipoid and fatty degeneration of the liver through feeding the fish on fatty fresh-fish diet. He observed[1]:

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[1] Mr. G. M. Malik informs me that 'In Kashmir daily removal of dead eggs before eyeing used to cause more loss than removal of dead eggs after eyeing. The practice therefore continues and no dead eggs are removed till the eyes appear when the ova can withstand disturbance or shocks'.

[2] Mr. G. M. Malik informs me that the records of diseases should be taken with caution as they are kept by semi-literate persons without making any *post-mortem* examination of the dead specimens.

'Normally the disease would have never occurred in the form of an epidemic but it was accentuated owing to unfavourable conditions that prevailed for several months preceding the epidemic. These were —shortage of water, insanitary conditions of the pens and over-crowding that resulted in abrasions, and subsequent attack by fungus. The malady was further aggravated by the breeding season when the vitality of the fish is naturally reduced as the epidemic was noticed just at the close of the breeding season.'

Of the 251 fishes that died in the Achhabal Farm during 1954-55, the following is the analysis of the causes of death as recorded in the Mortality Register by the Jamadar of the hatchery:

| | |
|---|---|
| Fungus (white patches) | 182 |
| Lipoid degeneration of the liver | 22 |
| Blindness | 17 |
| Injuries through otters | 14 |
| Spawn-bound | 9 |
| Muddy water | 4 |
| Fin rot | 3 |

It will be worthwhile to examine the causes of these diseases against the layout of the Farm and the cultural practices that are followed.

Fungus Infection: Though all freshwater fishes of various ages are liable to be attacked by the fungi or water-moulds (Saprolegniaceae), it is doubtful whether the fungus is the primary cause of the trouble. The fungus attacks only when it can obtain a foothold on an injured part of a fish—physical injury or that caused by external parasite. Susceptibility to infection is greatly increased if the fishes are suffering from general debility or are living under unfavourable conditions. Eggs are also subject to attack by the fungus and in most hatcheries the heaviest losses are in the egg stage.

The heaviest loss of adult fish occurs after stripping, in the months of December and January. In tank No. 19, where males and females of Brown Trout are kept for stripping, 17 males and 10 females died from fungus infection. The loss to the hatchery through stripping operations was about 200 lb. of trout from various tanks. In the handling of fish incidental to stripping, it is almost impossible to avoid injuring some of the fish slightly. As at the spawning season the vitality of the fish is usually lower, they are especially susceptible to infection by the fungus. According to Davis (1953, p. 279), 'fungus infection can often be prevented from developing in spawned fish by dipping them in a 1:15,000 solution of malachite green, or in a 3 per cent salt solution after they have been stripped.' They should be kept in the solution until they show signs of distress.

After stripping, the practice at this hatchery is to return the fish to the same tank which is usually crowded with other fish. I would suggest that they should be put in a special tank where greater care could be taken of them for a few days until they regain strength and vigour. Sometimes fish, particularly Rainbow Trout, bite off portions of caudal fin of other fishes and the injury thus produced gives a foothold to the fungus.

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[1] Malik, G. M., *Journ. Bombay Nat. Hist. Soc.*, 41: (2) 397-408, 1939.

At other periods also fungus infection accounts for a large number of deaths mostly among the yearlings, but the bigger fish are not immune from it. If the infection is detected in the early stages of the disease, one such treatment as indicated above is usually effective, but if the fungus is well established, even several successive treatments may not effect a cure. It is, therefore, most essential to prevent the development of disease.

I have already referred above to a loss of nearly 44% of ova, probably through the fungus infection, and suggested that dead ova should be picked out and removed as soon as detected. For still better results reference may be made to Davis (1953, pp. 280-281).

Lipoid Degeneration of the Liver: This disease is caused by malnutrition resulting from overfeeding or the use of unsuitable diets. At the Achhabal Hatchery fishes of over a pound in weight are fed on small pieces of country fish freshly collected each day from certain reserve streams. Few fishes of over a pound in weight die from this disease during the months May-June to August-September. During these months three Schizothoracine fishes, Khout (*Oreinus plagiostomus*), Zoobo and Kontgad or Choozge (*Schizothorax* spp.), run up the streams for breeding and are full of mature gonads. It is known that roe of these fish cause intestinal trouble in man (Annandale 1920, *Rec. Ind. Mus.*, xviii, p. 192). It is likely that some fish overfeed during that period and suffer from lipoid degeneration of the liver.

Some yearlings fed on dry meals, consisting of silkworm pupae and fish, have also suffered from this disease. These meals are concentrated fatty food and there are, therefore, more chances of getting a fatty liver when on this diet.

On the first appearance of the disease, it is better to isolate the fish and control its feeding till it fully recovers. Unfortunately, there is no serviceable isolation tank in the hatchery at present so it would seem difficult to save such fishes from death.

Blindness: Out of 17 cases, 8 occurred during August-September and most of the diseased fish were taken out from tank No. 12. I have found a large number of the *Lymnaea* snails in the hatchery tanks and have therefore presumed that the blindness may have been caused by the Eye Fluke (Strigeidae). The metacercariae of this fluke occur only in the lens of the eye and when abundant cause it to become white and opaque, so that the fish becomes partially or totally blind. For the control of this disease, the best thing will be to eliminate snails from the pond by first draining the pond, removing plants, and then the sides and bottom should be thoroughly cleaned and chlorinated to kill the hiding snails.

Depradation by Otters: Otters entered tank No. 16 from the spring side one night during October-November and injured several fish of which 14 died on subsequent days. On an inspection of the site it seems a proper fencing of the farm on the spring side may prevent such losses in future years.

Spawn-bound: Some female fish are unable to liberate their eggs and therefore die spawn-bound. There seems to be no remedy for it. Mr. G. M. Malik is of the opinion that spawn-bound condition is associated with high calcium content of the water, high temperature and accumulation of fat in the viscera.

Muddy Water: Though only 4 cases of death through muddy water have been registered, I am informed heavy mortality among fry, which are kept separately from the main stock, occurs as a result of the muddy water. The tank bottoms get covered with silt and these are cleaned only once a year. It will greatly improve the sanitation of the farm if a settling tank could be put up at the head of the stream feeding the farm and hatchery channels[1]. It may also help to check the fungus and liver diseases.

Fin Rot: This is a bacterial infection which usually first appears in the dorsal fin but may occasionally start in the caudal fin. It is noticeable as a distinct white line along the outer margin of the fin and then moves inwards and destroys the whole fin. This can be controlled by dipping the fish for one or two minutes in a 1:2,000 solution of copper sulphate. This is good treatment in the early stages of the disease. Several treatments at intervals of 24 hours are required before the spread of the disease can be effectively checked. If the fish is in an advanced stage of infection, it should be taken out and destroyed to save other fishes from getting infected.

## FOOD AND GROWTH

Up to a weight of 12 oz., the trout are fed on dried silkworm pupae and fish powdered to various grades of fineness for feeding young of different sizes. In Tank No. 12, 138 fish of 12 oz. to 1¼ lb. are kept on a mixed diet of silkworm pupae and small pieces of fresh country fish about a seer in weight. In Tank No. 15, 182 fish of 12 oz. to 1¼ lb. are fed on fresh fish about 1½ seers in weight once a day. In Tank No. 16, 176 fish of 14 oz. to 1½ lb. in weight are given about 2 seers of fish. In Tank No. 17, 210 fish of 1½ lb. to 2½ lb. are given 4 seers of country fish. Seventy-six fish in Tank No. 18 of 3 to 6 lb. in weight are given 4 seers of country fish, while 198 fish of 2 to 3 lb. in Tank No. 19 are given 5 seers. In Tank No. 20, 64 fish of 2 to 3 lb. are given 2 seers of country fish while 8 trout of 2½ to 3¼ lb. in Tank No. 20B are given half a seer. These figures are all approximate as the person who feeds the fish takes handfuls of chopped country fish from a bucket when feeding fish in each tank. The amount thrown in each tank cannot be accurate and it cannot be stated whether or not each fish had a feed.

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[1] Mr. G. M. Malik informs me that 'Plans for setting up a filtration system have already been approved and it is hoped that sedimentation troughs for hatcheries will be constructed next year'.

Three or two fishermen, according to seasons of scarcity or abundance of country fish in the reserve streams, are employed for catching local fish and naturally the quantity procured by them varies from day to day. Accordingly the ration of food given to fishes also varies. From the data collected by me for some other investigation, it appears that approximately 16 seers of country fish is brought to the hatchery daily by three fishermen from the middle of June to the middle of November, thus the ration for each tank given above is reduced to 4/5 for these months. From the middle of November to the end of March, only 2 fishermen are employed but they bring in an average of 22 seers every day. From the first of April, a third fisherman is employed and the quantity brought in increases to 26 seers on an average up to middle of May.

This system of feeding has one obvious defect. During the summer months when the fish are generally more active, the supply of food is less. When the food supply increases in winter, the fish are not so active and overfeeding may result in the lipoid degeneration of liver. It will be seen from the above that heaviest mortality occurs among the adult fish in December and January from fungus infection after stripping and this reduces the stock to be fed when the supply is abundant.

From what is stated above, it would seem highly desirable that the system of feeding should be rationalised for the health and proper growth of the fish. During winter months when Rapat, *Labeo diplostomus* (Heckel), is plentiful even in farm and hatchery streams, efforts should be made to collect large quantities and dry them up in a small drier to be used during the months of scarcity of food. This proposal involves only a small outlay but ensures equitable food supply throughout the year.

Feeding of trout with fish of the coarser and cheaper grades has certain disadvantages as pointed out by Davis[1] (p. 77). He says:

'Fresh fish of the coarser and cheaper grades have been used rather extensively for trout foods, but the results have not been entirely satisfactory. It usually requires about twice as much fish as meat to produce an equal growth. . . As already pointed out, the use of fish in trout diets frequently results in a vitamin $B_1$ deficiency, which may have disastrous results. If this is guarded against, fish may be safely included in the diet. In general, however, it is believed that the percentage of fish should not be higher than 20 to 25 per cent.'

The deficiency of thiamin, source of vitamin $B_1$, results from fish diet for there is some substance in the tissues of the fish which destroys vitamin $B_1$ on contact (Davis, p. 73). Loss of balance results from this disease at first occasionally but in course of time it develops into a complete inability to maintain a normal position, although the fish may live for weeks in this condition. To correct $B_1$ deficiency, wheat products, such as middlings, and livers are the best sources of thiamin. The plant meals are also stated to be fair sources of this vitamin.

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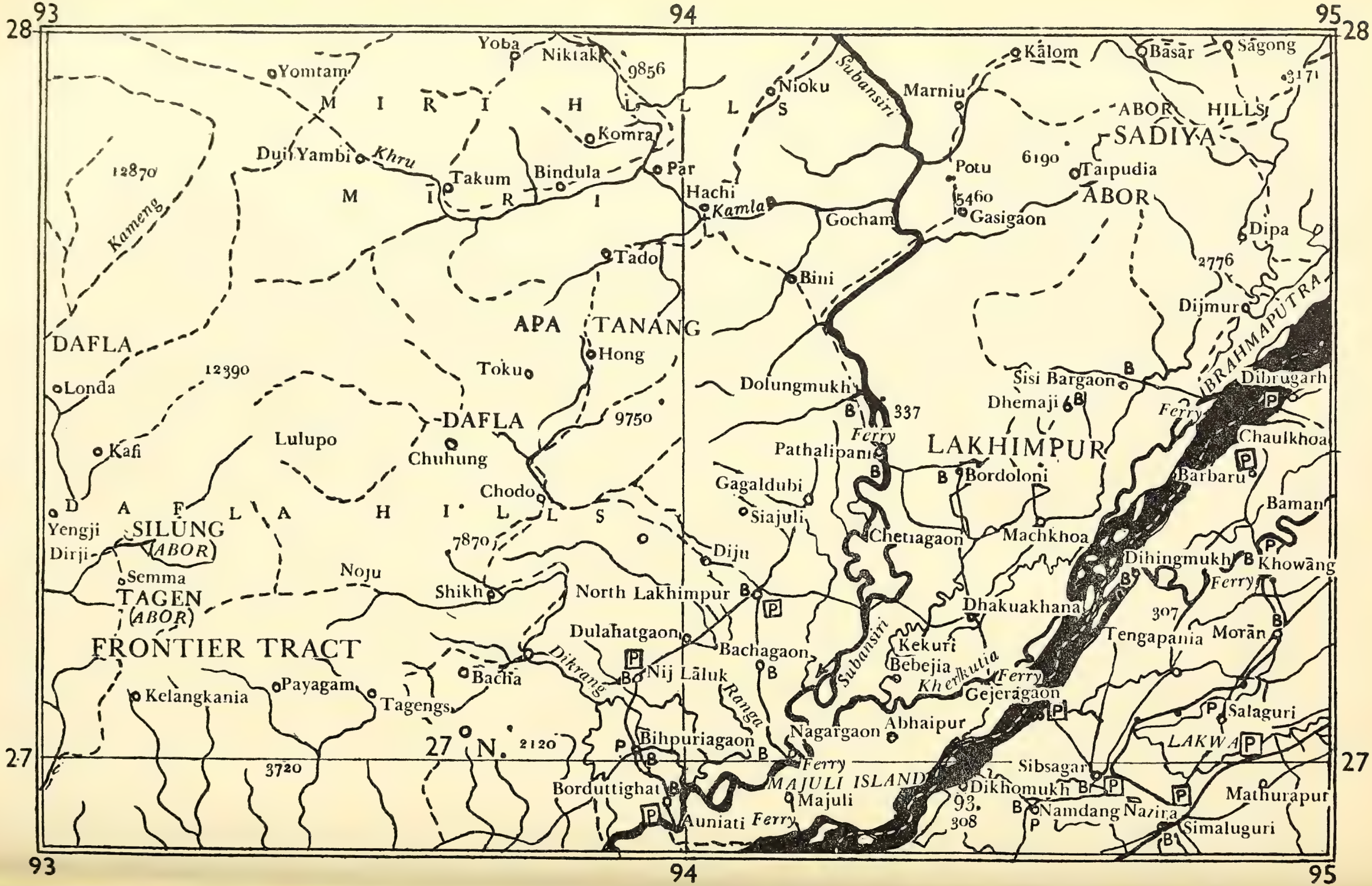
[1] Davis, H. S., 1953—*Culture and Diseases of Game Fishes,* University of California Press, Berkeley and Los Angeles.

Up to 3 years, the growth of trout is stated to be very slow, for during this period it only attains a weight of 14 oz. to 1 lb. After the third year, the growth may be a pound a year, for a 5 year fish may be 3 lb. in weight. How far this growth rate is associated with food supplied to the fish below 12 to 14 oz. and to those over a pound is difficult for me to say, but it is evident that a pound of trout costs several times more to the Government than the so-called exorbitant price of Rs. 3 per pound at which it is sold from the hatcheries. No commercial concern could possibly maintain a trout farm on this basis and it is necessary, therefore, that the working of these farms be reviewed and brought in line with modern developments and techniques, so as to make them a source of revenue and encouragement for private enterprise.

## CONCLUSIONS AND RECOMMENDATIONS

In view of what is stated above, it would be clear that some drastic changes in the layout and management of the Farm and Hatchery are called for. In the layout, sanitation of the premises and ponds should receive early consideration. A boundary wall, a small concrete reservoir at the spring, a good settling tank and filter beds for the hatchery, thinning of stocks with the building of more ponds among other measures are necessary to improve sanitation. An analysis of the spring water, analysis of the food values of country fish, ecology and biology of the fauna and flora of the trout ponds and channels are some of the basic scientific problems that need attention. The rational feeding of the fish, both qualitatively and quantitatively, is of the utmost importance. The practices of stripping, care of eggs and fingerlings should be modernised. In view of natural reproduction in the streams, the practice of stocking streams with eyed ova should be examined. There is need to produce more trout to meet tourist demand and I feel sure that the existing farms with suitable improvements can do the job.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Namdang
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Balipara Frontier Tract

Copied from Survey of India topo sheet N.G.—46. Scale 1″ = ca. 16 miles

# NOTES ON BIRDS OF THE SUBANSIRI AREA, ASSAM

BY

F. N. BETTS

(*With a map and one plate*)

The area under consideration is portion of the NE. frontier district of India bounded on the east by the Subansiri River, on the north by the Himalayan Range, and on the south by the North Lakhimpur District of Assam. On the west it adjoins the Balipara Frontier Tract.

## TOPOGRAPHY

The area comprises a complete cross-section of the southern slopes and foothills of the Himalayas, rising abruptly from the Assam plain and extending northward in a succession of steep and steadily heightening east/west ridges, terminating in the snow-clad summits of the main range running up to over 20,000 ft. The principal rivers run in deep gorges between the ridges and flow eastward, either debouching into the Subansiri, as does the Kamla, or, as in the case of the Par and Panior which are nearest the plains, turning sharply southwards at the termination of their course and cutting their own passages through the outermost range.

## THE APA TANI VALLEY

This is quite the most remarkable feature of the district. It lies at a height of 5,000 ft. surrounded by a ring of hills rising to 7,000 ft. and is a flat oval plain of about 20 sq. miles, probably the bed of a dried-up lake, and is the only considerable area of flat land in the whole district.

### Population

The Apa Tani Valley is thickly populated by a settled tribe practising permanent agriculture of an intensive type. The rest of the area is sparsely inhabited by Daflas, a primitive and savage people, who exist by hunting and shifting 'jhum' cultivation.

### Vegetation and Climate

The outer ranges rising steeply from the Assam plains to a height of 4/5,000 ft. receive the full force of the SW. monsoon and experience a very heavy rainfall. They are covered from foot to summit by dense tropical rain forest. This also extends along the bottom of the gorges of the principal rivers far into the hills, gradually changing into a drier type, often deciduous and much mixed with giant bamboo. The interior ranges have a much drier climate, and up to 5,000 ft. have been denuded of their original forest by Dafla 'jhuming'. Where the population is low there is a regenerated growth of secondary woodland of a more temperate character, mostly evergreen oak and chestnut, but over wide areas, as in the Pein Valley, the trees have gone for good and the hillsides are covered in long, coarse thatching grass. The Daflas do not live or cultivate much above 5,000 ft. and the summits of the ridges above this altitude are again covered in heavy evergreen forest though of a less tropical type than that of the outer range.

This description holds good for the country to a depth of 50–60 miles north from the plains, which is as far as exploration has gone. Further in, no doubt, as in the neighbouring Balipara Frontier Tract, one reaches the truly temperate zone characterised by *Pinus excelsa* and deciduous oak at the foot of the main range merging into rhododendron and alpine flora at higher altitudes. In the part of the area under consideration in this paper, however, there is no natural coniferous forest.

The Apa Tani Valley is a complete contrast to the rest of the district. The flat floor is cultivated throughout with terraced paddy fields wherever irrigation is possible, and millet in the drier parts. Round the large villages are carefully fenced and tended vegetable gardens and plantations of *Pinus excelsa* and a species of bamboo which are grown for use in building and as firewood. Neither pine nor bamboo are locally indigenous and were brought with the tribe on their original immigration which must have taken place many hundred years ago as some of the pines are of enormous size. The comparatively small area which remains uncultivated consists of low, bracken-covered hummocks which in spring are a mauve sea of *Primula denticulata*.

The winter climate is severe as a heavy mist settles each evening and does not disperse until ten o'clock in the morning; and in December and January there are hard night frosts. The Valley lies on a main migration route between the Indian plains and Central Asia and in the spring, particularly, the fallow paddy land is a favourite halting place for a great variety of waders and waterfowl.

The list which follows probably includes less than 30% of the species which actually occur in the area. I spent eighteen months there, but had very little time for serious ornithological work, while the high evergreen forest with its tangled undergrowth of bamboo and cane which covers so much of the country is extremely difficult to work thoroughly. The specimens I obtained are in the British Museum of Natural History, South Kensington. The nomenclature and sequence are mainly those of the Fauna of British India, Stuart Baker, as corrected in Vol. 8 of that work. I have used trinomials only where specimens have been collected and identified.

## List

1. **Corvus macrorhynchos.** Jungle Crow.

Dafla name : *Poa.*

Numerous in the Apa Tani Valley and in the big permanent Dafla villages of Talo and Jorum on its outskirts. Elsewhere scarce. It breeds in May in the pine trees round the Apa Tani villages, and also on the fringes of the forest bordering the cultivated land. No specimens were obtained so that it is unknown whether the Himalayan or Burmese subspecies is the form which occurs.

2. **Urocissa flavirostris.** Yellowbilled Magpie.

Not encountered in the part of the Subansiri area proper which I was able to visit as suitable biotope was absent. On a tour to the Tibetan frontier in the neighbouring Balipara Frontier Tract, however, I found it common in the deciduous oak—*Pinus excelsa* woods from 8,000-12,000 ft.

3. **Cissa chinensis.** Green Magpie.

Scarce. Seen at Pite, 2,000 ft, in bamboo and mixed forest and once at Kore, 4,500 ft., in evergreen forest. It is a noisy bird but keeps to the canopy of high forest and is hard to observe.

4. **Dendrocitta formosae himalayensis.** Himalayan Tree-pie.

Occurs throughout the area but is most numerous in the tropical rain forests of the outer ranges, particularly at low elevations in bamboo and riverine woodland. Usually one or two are seen in mixed hunting parties, but sometimes one encounters family parties of five or six alone. Two specimens obtained at Pite, 1,500 ft., on the Panior River on 10-10-46 were in moult.

5. **Dendrocitta frontalis.** Blackbrowed Tree-pie.

I believe I saw this bird on one occasion on Tasser Puttu on the outer range in heavy evergreen jungle at 4,500 ft. The back of the crown and occiput were almost white.

6. **Nucifraga caryocatactes hemispila.** Nutcracker.

This nutcracker was common on the Se La in the Balipara Frontier Tract near the Tibetan border in the alpine woods and meadows near villages from 8,000-12,000 ft.

7. **Parus monticolus monticolus.** Greenbacked Tit.

Fairly common in open woods and secondary jungle from 5,000 ft. upwards. It occurs in cultivated land in the Apa Tani Valley. A specimen was shot at Kore, 5,000 ft. and a pair were seen there on May 20 carrying caterpillars to a hole in a tree-branch at a height of 25 ft.

8. **Machlolophus spilonotus.** Blackspotted Tit.

Seen at all seasons in light forest on the hills round the Apa Tani Valley, 5–6,000 ft., usually in mixed flocks with other insectivorous birds.

9. **Aegithaliscus concinnus iredalei.**[1] Redheaded Tit.

Frequents lightly-wooded country at Kore, 5,000 ft., and the Apa Tani Valley in cultivation, pine and bamboo groves and the scrubby firewood reserves. Usually in family parties of 7 or 8, often with other species.

10. **Melanochlora sultanea.** Indian Sultan Tit.

Widely distributed and fairly common in evergreen forest from the lowest elevations up to 4,000 ft. Usually seen in small parties of 3 or 4 in company with other insectivorous species. Keeps to the tree tops.

11. **Suthora poliotis daflaensis.** Dafla Suthora.

Not uncommon in flocks in secondary scrub in the Apa Tani firewood reserves at about 6,000 ft. A specimen was obtained.

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[1] or *rubricapillus* ?—Eds.

12. **Sitta castaneiventris.** Cinnamonbellied Nuthatch.

Not uncommon at medium elevations, 2–5,000 ft. in light or secondary forest.

13. **Sitta formosa.** Beautiful Nuthatch.

Rare. Only seen twice, on both occasions in the canopy of high-elevation forest. A specimen was obtained at 7,000 ft. between Kore and the Apa Tani Valley.

14. **Dryonastes ruficollis.** Rufousnecked Laughing Thrush.

Occurs in the plains at the foot of the outer range, but also commonly in the Pein Valley, 4,000 ft., haunting the 'sholas' and scrub in the hollows of the thatch-grass clad downs. Also seen on the borders of the Apa Tani Valley in the scrubby firewood reserves at Hapulia, 5,000 ft. A noisy species with sweet whistling calls.

15. **Garrulax leucolophus.** Whitecrested Laughing Thrush.

Common in the river valleys in bamboo and mixed forest but not seen above 3,000 ft. A specimen was shot out of a large flock on the Pein River at 1,500 ft.

16. **Garrulax moniliger.** Indian Necklaced Laughing Thrush.

Distribution similar to the last. Occurs in very large parties of thirty or forty birds and is extremely noisy.

17. **Ianthocincla rufogularis.** Rufouschinned Laughing Thrush.

A flock was seen in secondary scrub jungle at Kore, 5,000 ft., in April. They were making a great noise and were apparently pairing off.

18. **Trochalopterum erythrocephalum.** The Redheaded Laughing Thrush.

Occurs in flocks in 'sholas' and scrub in the valleys of the Pein River downs. Two specimens were obtained on the Kale River at 4,500 ft.

19. **Trochalopterum phoeniceum phoeniceum.** Assam Crimsonwinged Laughing Thrush.

Uncommon. A specimen was shot out of a flock feeding with a large mixed hunting party in dense bracken and scrub on Kore hill at 5,000 ft. Also seen in the undergrowth of high evergreen forest between Kore and the Apa Tani Valley at 6,000 ft.

20. **Grammatoptila striata.** Striated Laughing Thrush.

A specimen was shot out of the tree-tops in high evergreen forest above the Apa Tani Valley at 6,000 ft. It was the only one ever seen in the district.

21. **Pomatorhinus ferruginosus ferruginosus.** Coralbilled Scimitar Babbler.

Dafla name : *Te churi.*

Uncommon. Specimens were brought in by Daflas caught locally at Kore, 5,000 ft.

22. **Xiphiramphus superciliaris.** Slenderbilled Scimitar Babbler.

A solitary specimen was seen in thick evergreen forest on Tasser Puttu at 4,000 ft. on the plains slope. A mixed insectivorous hunting flock was feeding in the trees above, but this bird went bounding away over the ground in long ratlike hops, making such a raucous screaming that I suspected a nest but could not find one. It was a big, chestnut brown scimitar babbler with an astonishingly long, slender, curved bill, quite unmistakable.

23. **Stachyris chrysaea.** Goldenheaded Babbler.

A common bird in the scrub of the firewood reserves round the Apa Tani Valley at 5–6,000 ft. Usually seen in mixed flocks with *Alcippe nipalensis* and other small birds. It is an active and restless species, slipping through the bamboos and undergrowth, seldom ascending high trees, and rarely, if ever, dropping to the ground. I saw a pair carrying bamboo leaves in May but failed to find the nest. This was in the Apa Tani woods at 6,000 ft.

24. **Alcippe nipalensis.** Nepal Babbler.

Common in the Pein Valley in scrub and light jungle. A specimen was shot at Kore, 5,000 ft.

25. **Pseudominla castaneiceps castaneiceps.** Chestnutheaded Babbler.

A specimen was obtained. Exact locality not recorded.

26. **Heterophasia picaoides.** Longtailed Sibia.

I saw one at Lichi in the valley of the Panior River at 3,000 ft. in tall scrub in a clearing in evergreen forest.

27. **Leioptila gracilis.** Grey Sibia.

On Donko Puttu, a hill above the Apa Tani Valley I saw a sibia with a black head, grey upper parts and whitish underparts which looked like this bird and not *L. annectens*. This was in evergreen forest at 7,000 ft. but only just beyond the pine belt. I also believe I have heard its distinctive, melancholy call round the Apa Tani Valley. I was unfortunately unable to shoot a specimen, and as this species is not recorded north of the Brahmaputra, the identification must remain subject to confirmation.

28. **Leioptila annectens annectens.** Blyth's Sibia.

I shot a specimen in an alder coppice at Kore, 5,000 ft.

29. **Leioptila pulchella pulchella.** Beautiful Sibia.

Not uncommon in high, evergreen forest on the crests of the higher hills at 6–7,000 ft. They go about in pairs or small parties, feeding mostly on the moss-grown trunks of the trees and not in the canopy. They hop actively along the big boughs, stopping abruptly at intervals, and at first sight with their jerky movements may quite easily be mistaken for one of the small tree squirrels also found there. I shot two specimens on Pad Puttu, 7,000 ft., and on the divide between Kore and the Apa Tani Valley.

30. **Sibia nipalensis daflaensis.** Austen's Barwing.

Found in the high evergreen forest on the summits of the highest ranges above 7,000 ft. Here it is common, going about in parties of 5 or 6, and is very noisy with most peculiar call notes. They feed largely in the tree-tops and upper mossy branches, but are extremely tame and curious, and when I was camping on Pad Puttu in a snowstorm, several came down to within a few feet of me to have a look. Two specimens were shot on Pad Puttu and Donko Puttu.

31. **Siva cyanouroptera cyanouroptera.** Hodgson's Bluewinged Siva.

A common bird in the bramble and secondary growth round Kore. It is also one of the few species fairly common in the cultivation and pine and bamboo plantations of the Apa Tani Valley. It is usually seen in considerable flocks in company with *Leiothrix* and *Mesia.*

32. **Yuhina gularis.** Stripethroated Yuhina.

I saw a flock of largish, brown-crested yuhinas on Donko Puttu above the Apa Tani Valley in the tree-tops at 7,000 ft. which I doubtfully identified as this species. I have also seen the same birds among rhododendron growth on the divide between Kore and the Apa Tani Valley.

33. **Yuhina nigrimentum nigrimentum.** Blackchinned Yuhina.

Not uncommon in flocks in the high evergreen woods of the Apa Tani hunting ground, 6,000 ft.

34. **Ixulus occipitalis.** Chestnutheaded Ixulus.

35. **Ixulus flavicollis flavicollis.** Yellownaped Ixulus.

Both the above were common all round the Apa Tani Valley in the forests on the hills, also in the open bramble and alder growth round Kore. They occurred in considerable flocks, feeding both in the tree-tops and in the undergrowth. A specimen I obtained of *I. flavicollis* was identified as the typical subspecies and not *baileyi.*

36. **Leiothrix lutea.** Redbilled Leiothrix.

Common round every Dafla village in recently abandoned 'jhum' land. Very common round Kore and in the scrubby Apa Tani firewood reserves, but not seen in the cultivated area in the Apa Tani Valley. The male has a sweet little song of half a dozen notes. It is very like *Mesia argentauris* in habits and frequently consorts with that species. I found a nest (c/2) on May 20 at Hapulia, 5,000 ft., beside a path in dense scrub.

37. **Cutia nipalensis.** Nepal Cutia.

Only once encountered when a pair were seen in the canopy of high forest on Tasser Puttu, 4,500 ft., the crest of the outer range.

38. **Pteruthius erythropterus.** Redwinged Shrike Babbler.

Only twice seen. I shot a solitary specimen at Kore, 5,000 ft. It was feeding on a leafless tree and was slow and sluggish in its movements. A small flock was encountered on another occasion in scrub at the edge of the Apa Tani firewood reserves.

39. **Chloropsis hardwickii hardwickii.** Orangebellied Chloropsis.

Occurs all over the hills in forest both in the mixed bamboo and deciduous riverine jungle at 2,000 ft. and the high evergreen forest at 7,000 ft. or more.

40. **Mesia argentauris argentauris.** Silvereared Mesia.

Very common in large flocks in scrub and light jungle throughout the Pein Valley and in the Apa Tani firewood reserves and bamboo plantations. They pair off in April and retire to scrubby nullahs where they become shy and hard to see, but can be detected by their long-drawn call note. A specimen was shot at Kore, 5,000 ft.

41. **Minla ignotincta.** Redtailed Minla.

Dafla name : *Pobhum dasin.*

Quite common in the winter all over the hills from 3,000 ft. upwards but most numerous at about 4–5,000 ft. They are sometimes found in separate flocks in scrub and light tree jungle but are generally in mixed parties, and work the tree-trunks like a tree-creeper or piculet.

42. **Criniger gularis.** Indian Whitethroated Bulbul.

Occurs in evergreen jungle in the lower foothills up to 4,500 ft.

43. **Microscelis psaroides.** Black Bulbul.

One of the commonest bulbuls all over the higher hills, descending to lower levels in winter. Usually seen in noisy flocks in the tree-tops. Specimen not obtained, and it is not known whether the form occurring is *psaroides* or *nigrescens.*

44. **Ixos flavala.** Himalayan Browneared Bulbul.

Common in mixed flocks in the secondary woodland and sholas of the Pein Valley. Specimens shot on Oct. 10, were in moult.

45. **Ixos macclellandi macclellandi.** Rufousbellied Bulbul.

This large bulbul is not uncommon in secondary 'jhum' scrub with a fair proportion of larger trees, such as is found around Kore. Usually seen in twos or threes in mixed flocks. The white throat of loose, lanceolate feathers is very noticeable in the field.

46. **Alcurus striatus.** Striated Green Bulbul.

Not common, but was seen in various places at fairly high elevations, usually in high tree-tops on the edge of evergreen forest. They are usually in pairs and are very noisy.

47. **Molpastes cafer.** Bengal Redvented Bulbul.

Dafla name : *Nieli betom.*

Very common in open country such as the Pein River downs up to 5,000 ft. A specimen was shot at Yatchuli, 4,000 ft., and a nest with 2 incubated eggs was found at the same place in an isolated bush in grassland on 25th May.

48. **Otocompsa jocosa emeria.** Bengal Redwhiskered Bulbul.

Dafla name: *Dukshoh.*

Very common everywhere in the open country of the Pein downs, gathering at times into considerable flocks.

49. **Certhia discolor discolor.** Sikkim Tree-creeper.

A specimen was obtained, but the locality not recorded.

50. **Tesia castaneocoronata.** Chestnutheaded Wren.

A wren which I believe to be this species is not uncommon in the scrubby firewood reserves on the hillsides bordering the Apa Tani Valley at 5-6,000 ft.

51. **Cinclus pallasi.** Indian Brown Dipper.

Common on all the larger rivers and streams from 2,000 ft. upwards; at the lower elevations only in winter.

52. **Saxicola torquata.** Indian Bushchat.

Common in winter in the open country of the Pein River downs and the Apa Tani Valley. I saw a pair in April on the downs at Jorum. The male was in full plumage and I suspect they were breeding.

53. **Rhodophila ferrea ferrea.** Western Dark-grey Bushchat.

Occurs all over the hills in 'jhum' cultivation round Dafla villages and is one of the few species permanently resident and breeding in the highly cultivated Apa Tani Valley. A nest with four eggs was found at Duta on April 20. It was a cup lined with hair in a hole in one of the thick brushwood fences which surrounded the bamboo groves which the Apa Tanis cultivate. The eggs were immaculate Hedgesparrow blue.

54. **Enicurus maculatus.** Spotted Forktail.

Occurs on the smaller rapid streams in heavy forest at all elevations and to a lesser extent on the larger rivers. It is not numerous.

55. **Enicurus schistaceus.** Slatybacked Forktail.

Distribution as the last species but commoner—the commonest forktail of the area. I found a nest being built on May 28 on the Petti Pobhu stream in the Panior Valley at 2,000 ft. It was on a large boulder two feet above water level in the stream bed. It was a solid cup of moss, soaking wet, and was being lined with blackish roots.

56. **Enicurus leschenaulti.** Leschenault's Forktail.

Found along the larger rivers and their tributaries in heavy forest up to 2,000 ft. but not common.

57. **Microcichla scouleri.** Little Forktail.

Seen once on the Kale River at 3,500 ft.

58. **Phoenicurus frontalis.** Bluefronted Redstart.

Seen at Kore, 5,000 ft. in December. A winter visitor presumably.

59. **Phoenicurus hodgsoni.** Hodgson's Redstart.

A pair once seen at Kore. Winter visitor.

60. **Chaimarrhornis leucocephala.** Whitecapped Redstart.

A common winter visitor on all the larger rivers at all heights.

61. **Rhyacornis fuliginosa.** Plumbeous Redstart.

To be seen on all the rivers and streams in the area in winter. I strongly suspect it of breeding in the district at higher elevations. A pair on the Pein River below Kore at 4,500 ft. appeared from their actions to have a nest, though I failed to find it.

62. **Copsychus saularis.** Magpie-Robin.

Rare in the hills. The only ones seen were a pair which were feeding young on April 30 in a hole 30 feet up in a tree in the open grassland of the lower Pein Valley.

63. **Turdus merula albocinctus.** Whitecollared Blackbird.

A small party were seen in January on Pad Puttu, 6,000 ft. in thick forest.

64. **Turdus boulboul.** Greywinged Blackbird.

One was seen at 4,500 ft. in ' jhums ' on the edge of forest.

65. **Turdus ruficollis.** Redthroated Thrush.

66. **Turdus atrogularis.** Blackthroated Thrush.

67. **Turdus unicolor.** Tickell's Thrush.

68. **Turdus obscurus.** Dark Thrush.

All these thrushes are common winter visitors in open country and secondary scrub all over the hills. They wander about in large flocks and the species mix freely.

69. **Geokichla citrina.** Orangeheaded Ground Thrush.

Not very common but resident in heavy evergreen jungle at moderate elevations. I found a nest almost certainly of this species on May 27. It was a sturdy cup, largely made of moss and lined with rootlets, 10 feet up in a low tree overhanging the path in thick forest at 3,500 ft. on the north slopes of Tasser Puttu.

70. **Oreocincla dauma.** Smallbilled Mountain Thrush.

Once seen in November in a wooded ravine below Kore, 4,500 ft.

71. **Oreocincla mollissima.** Plainbacked Mountain Thrush.

I shot one of a pair in December at 5,000 ft. above Kore in the Apa Tani woods.

72. **Myiophoneus caeruleus.** Himalayan Whistling Thrush.

Not very common. One or two were seen on hill-streams on the slopes of Tasser Puttu, 4,500 ft.

73. **Siphia strophiata strophiata.** Orangegorgeted Flycatcher.

A fairly common winter visitor. A specimen was obtained at Kore.

74. **Muscicapula melanoleuca.** Little Pied Flycatcher.

Arrives in the hills above 4,500 ft. in considerable numbers in March, presumably to breed. They haunt fairly open country and cultivation. I have seen them at Kore, the Pein Valley 'sholas' and the Apa Tani Valley.

75. **Eumyias thalassina.** Verditer Flycatcher.

Occurs in fair numbers all over the hills at all times of the year. I have seen it up to 7,000 ft. It is usually found in cultivation or secondary jungle. A tall dead tree in cleared 'jhum' land makes a very favourite look-out. It has a sweet little song.

76. **Anthipes monileger monileger.** Hodgson's Whitegorgeted Flycatcher.

A specimen was obtained and others seen in scrubby ravines in broken country below Kore, 4,500 ft.

77. **Culicicapa ceylonensis.** Greyheaded Flycatcher.

A regular member of the mixed hunting flocks in evergeen forest all over the hills. It is a permanent resident and the commonest flycatcher of the district.

78. **Niltava grandis grandis.** Large Niltava.

Seen on several occasions in undergrowth and low trees under high forest on the borders of the Apa Tani Valley at 6,000 ft.

79. **Niltava macgrigoriae.** Small Niltava.

Uncommon. Similar in habitat and distribution to *N. grandis.*

80. **Tchitrea paradisi.** Indian Paradise Flycatcher.

Only seen in the 'terai' forest belt at the foot of the hills adjoining the plains at 2–3,000 ft. The subspecies occurring was not ascertained.

81. **Rhipidura albicollis.** Whitethroated Fantail Flycatcher.

Occurs all over the hills. Usually seen as single birds accompanying mixed insectivorous flocks in forest.

82. **Lanius nigriceps.** Indian Blackheaded Shrike.

Common in open country such as the Pein Valley downs, and is one of the few species breeding in numbers in the highly cultivated Apa Tani Valley. It nests throughout May in the small patches of scrub in the hollows of the bare, bracken-clad grazing grounds. The nest is in any conspicuous thorny bush. Almost every patch of scrub has a pair. The clutch is 4–6.

83. **Hemipus picatus capitalis.** Brownbacked Pied Shrike.

Quite common all over the hills up to 7,000 ft., usually in pairs or small family parties.

84. **Pericrocotus brevirostris affinis.** Assam Shortbilled Minivet.

A specimen was obtained but locality not recorded.

85. **Lalage melaschista.** Dark-grey Cuckoo-shrike.

Occurs fairly commonly in riverine bamboo jungle and the oak and chestnut woods of old abandoned ' jhum ' land, but not seen in the virgin evergreen forest of the high hills.

86. **Graucalus macei.** Large Himalayan Cuckoo-shrike.

Occurs sparsely all over the hills in secondary open jungle and abandoned ' jhums '.

87. **Dicrurus macrocercus.** Black Drongo.

88. **Dicrurus leucophaeus.** Grey Drongo.

Both these drongos occur commonly at low elevations in the river valleys.

89. **Chaptia aenea aenea.** Northern Bronzed Drongo.

Fairly common around Dafla villages and new ' jhum ' clearings. Birds seen at Selsemchi, 1,500 ft., on the outer range in October were in moult with the tail feathers growing. It occurs in the Apa Tani Valley and may well breed there in the pines as I have seen a pair in May chasing a crow out of a grove.

90. **Chibia hottentotta.** Haircrested Drongo.

Fairly common at low and medium elevations in the forest bordering on ' jhum ' clearings. A specimen was shot at Lichi, 3,000 ft., on May 27. I saw two pairs building in this neighbourhood at Petti Pobhu in evergreen jungle. One nest was in the outer branches of a high tree, but the other was not more than 15 ft. up in a tree overhanging a stream. Both were hammocks of bark and rootlets like that of *Dissemurus*, and lacked the cobweb plastering used by the smaller drongos.

91. **Bhringa remifer.** The Indian Lesser Racket-tailed Drongo.

Seen on several occasions up to 4,000 ft. in heavy forest on the outer ranges.

92. **Dissemurus paradiseus.** Large Racket-tailed Drongo.

Not common but occurs, usually in pairs, in mixed flocks with tree-pies and other birds up to 7,000 ft. in dense forest.

93. **Franklinia gracilis.** Franklin's Wren-Warbler.

Common round Kore, 5,000 ft. on the bracken-clad hillsides in small parties.

94. **Seicercus affinis.** Allied Flycatcher-Warbler.

A specimen was obtained, but the locality not recorded.

95. **Seicercus poliogenys.** Greycheeked Flycatcher-Warbler.

Very common all round the Apa Tani Valley in the scrubby firewood reserves at about 6,000 ft. A constant member of the mixed hunting parties.

96. **Abrornis schisticeps.** Blackfaced Flycatcher-Warbler.

I saw a pair on one occasion in the Apa Tani firewood reserves in a mixed hunting party.

97. **Abrornis albogularis albogularis.** Whitethroated Flycatcher-Warbler.

A low elevation species. I shot a specimen, one of a pair, in bamboo and deciduous forest on the river bank at Pein, 3,000 ft.

98. **Horornis pallidipes.** Blanford's Bush-Warbler.

I found a nest which must have belonged to this species (or *H. fortipes* ?) at Likha, 4,000 ft. by a path running through abandoned 'jhums', overgrown with thatch-grass and brambles. It was three feet from the ground, a very deep and bulky cup of dead leaves, lined with feathers, some of them green, and contained 4 eggs of a uniform deep purplish chocolate.

99. **Prinia flaviventris.** Yellowbellied Wren-Warbler.

Occurs in grassland in the Pein Valley round Yatchuli at 3,500 ft.

100. **Irena puella.** Fairy Bluebird.

Occurs somewhat uncommonly in the river valley forests up to 3,000 ft.

101. **Oriolus traillii.** Maroon Oriole.

Not uncommon in the forest on the hills round the Apa Tani Valley at 6,000 ft. Unlike the golden orioles it is a very silent bird.

102. **Saroglossa spiloptera assamensis.** Assam Spottedwinged Stare.

Only once encountered when three specimens were shot from a large flock on the outskirts of a 'shola' on the Pein River downs at 3,500 ft. on October 10. One of them, a female, was in moult.

103. **Munia atricapilla.** Northern Chestnutbellied Munia.

An inhabitant of swamps at low elevations at the foot of the hills.

104. **Uroloncha striata.** Hodgson's Munia.

Common all over the hills in secondary 'jhum' cultivation in small flocks.

105. **Passer rutilans cinnamomeus.** Cinnamon Tree-sparrow.

Dafla name: *Pichi.*

Occurs round the Apa Tani villages and cultivation in fair numbers. I found them breeding at Duta, 5,000 ft., in May in holes in wild pear trees, several nests in one tree. The nests are pads of pine needles. The usual clutch was 4 and the eggs were very variable.

106. **Emberiza pusilla.** Little Bunting.

A fairly common winter migrant in open country, particularly in the Apa Tani Valley.

107. **Melophus lathami.** Crested Bunting.

In winter occurs in flocks all over the hills in open thatch grass country. It is apparently a breeding visitor to the Apa Tani Valley where it is one of the few birds inhabiting the bare, bracken-covered grazing grounds. From late April on they are numerous there in pairs, but up to the end of May I failed to find a nest and even then some of the males were in winter plumage.

108. **Anthus hodgsoni hodgsoni.** Indian Tree Pipit.

A specimen was obtained, but the locality not recorded.

109. **Aethopyga saturata saturata.** Blackbreasted Sunbird.

Widely but sparingly distributed at all elevations both in open 'jhum' land and the dense forests round the Apa Tani Valley up to 6,000 ft.

110. **Pitta nipalensis.** Bluenaped Pitta.

Once seen. A female was shot on the ground at 6,000 ft. in dense forest on the border of the Apa Tani Valley.

111. **Pitta cucullata.** Greenbreasted Pitta.

I saw a pair in the Kimin Nullah at 500 ft. in the foothill 'terai' forest on 25-5-47. They were flying about together in a purposeful manner as though nest-building or feeding young.

112. **Serilophus rubropygius.** Hodgson's Broadbill.

Once seen. A specimen was shot in bamboo jungle on the banks of the Panior River at Pite, 1,500 ft.

113. **Psarisomus dalhousiae.** Longtailed Broadbill.

Occurs in flocks in riverine jungle along the Panior River and its tributaries up to 3,000 ft.

114. **Dryobates darjellensis.** Darjeeling Pied Woodpecker.

A specimen was obtained, but the locality not recorded.

115. **Dryobates nanus.** Pigmy Woodpecker.

Seen in woodland patches on the Pein River downs, usually in mixed flocks with other insectivorous birds.

116. **Blythipicus pyrrhotis.** Redeared Woodpecker.

Heard and seen on a number of occasions in riverine evergreen and bamboo forest.

117. **Mulleripicus pulverulentus.** Indian Great Slaty Woodpecker.

A bird of low elevations, only seen in the tall evergreen forest of the 'terai' at the foot of the hills near the Kinin River.

118. **Vivia innominatus innominatus.** Speckled Piculet.

119. **Sasia ochracea ochracea.** Rufous Piculet.

Both these piculets were seen together in company with minlas, sivas and mesias in mixed hunting parties in patches of woodland on the Pein River downs.

120. **Megalaima virens magnifica.** Great Himalayan Barbet.

Common all over the hills at all elevations.

121. **Megalaima asiatica asiatica.** Bluethroated Barbet.

Common all over the hills at all elevations.

122. **Megalaima franklinii.** Goldenthroated Barbet.

Not uncommon in the tall evergreen forest of the Apa Tani hunting ground at 5–6,000 ft.

123. **Cuculus canorus.** Asiatic Cuckoo.

A form of the cuckoo, probably subspecies *telephonus*, occurs not very commonly on the higher hills above 4,000 ft. during the breeding season.

124. **Cuculus optatus.** Himalayan Cuckoo.

Very common in the high woods of the Apa Tani hunting grounds above 5,000 ft.

125. **Cuculus poliocephalus.** Small Cuckoo.

A common summer visitor to the hills. One was shot at Kore, 5,000 ft., in April.

126. **Cuculus micropterus.** Indian Cuckoo.

Very common indeed all over the hills.

127. **Surniculus lugubris.** Drongo Cuckoo.

Seen once in ' jhum ' cultivation at Likha, 4,000 ft.

128. **Clamator coromandus.** Redwinged Crested Cuckoo.

Seen once or twice in April and May in secondary jungle at fairly low elevations.

129. **Centropus bengalensis.** Lesser Coucal.

Common in the thatch-grass covered downs of the Pein Valley at 3–4,000 ft. One which I disturbed on a very dewy morning was so soaked that it could scarcely fly.

130. **Eurystomus orientalis.** Broadbilled Roller.

Not uncommon at low elevations in ' jhum ' clearings along the Panior Valley. Its favourite hunting stances are the tall dead trees left after the forest has been burned for clearing.

131. **Ceryle lugubris.** Himalayan Pied Kingfisher.

Found all along the Panior and other large rivers of the district, though thinly distributed as each pair seems to occupy a long stretch of water.

132. **Alcedo atthis.** Common Indian Kingfisher.

The only kingfisher seen in the Apa Tani Valley where it occurs on the Kale River at 5,000 ft.

133. **Alcedo hercules.** Blyth's Kingfisher.

Seen once on May 27 on the Petti Pobhu, a small stream running through dense evergreen forest at 2,000 ft. A bird passed me three times in an hour carrying a fish in its beak and evidently feeding young. I was unable to find the nest, however.

134. **Dichoceros bicornis.** Great Hornbill.

Only seen at comparatively low elevations up to 2,000 ft. in the evergreen forest along the Panior River.

135. **Rhyticeros undulatus.** Malayan Wreathed Hornbill.

Common in small parties in evergreen forest throughout the hills from plains level up to 6,000 ft. The call is a loud croak but it is not nearly so vociferous as most hornbills. They are very shy and wary, being, like the other large members of the family, much hunted by the local tribesmen not only for food but for the sake of their casques and tail-feathers which are worn as head-dress ornaments.

136. **Aceros nipalensis.** Rufousnecked Hornbill.

Not common. A pair were seen on Tasser Puttu, 4,000 ft., in heavy forest.

137. **Harpactes erythrocephalus.** Redheaded Trogon.

Not common. One was seen in a mixed hunting party in riverine bamboo jungle at Pite, 2,000 ft., and a specimen was shot at Talo, 5,000 ft., in evergreen forest.

138. **Harpactes wardii.** Ward's Trogon.

Only once encountered. A party of a male and two females was seen in evergreen forest above Kore, 5,500 ft. and one of the females was collected.

139. **Cypsiurus batassiensis.** Palm Swift.

Seen round the Dafla village of Selsemchi, 1,800 ft. They probably breed in the thatched eaves of the houses as they do in Naga villages in the hills where the normal nesting sites are not available owing to the absence of palm trees.

140. **Hirundapus giganteus.** Brownrumped Spinetail.

I watched a large flock of fifty or more flying up and down a stretch of the Panior River, 2,000 ft., one evening. A dozen or so at a time would swoop down and dip in the river simultaneously raising a series of longitudinal splashes like a shoal of flying fishes taking wing.

In April I have seen isolated pairs hawking round clearings where the swamps of the Apa Tani Valley run up into the forest at 5,000 ft., and I suspect that they were breeding there.

141. **Ictinaëtus malayensis.** Black Eagle.

The only large raptor at all common in the hills. I once saw a flock of over twenty circling together over the Pein Valley. Usually they are solitary. One was shot at Kore while raiding a chicken-run.

142. **Spilornis cheela.** Crested Serpent Eagle.

Not uncommon in river valleys and ravines at fairly low elevations.

143. **Baza jerdoni.** Blyth's Baza.

A pair were seen soaring and mewing over the 'terai' jungle at Dejoo on the edge of the plains.

144. **Dendrophassa pompadora phayrei.** Pompadour Green Pigeon.

A specimen was obtained, but the locality not recorded.

145. **Sphenocercus apicaudus.** Pintailed Green Pigeon.

A specimen was obtained at Selsemchi, 1,500 ft.

146. **Sphenocercus sphenurus.** Wedgetailed Green Pigeon.

Numerous round Kore, 5,000 ft., in April when a certain berry was in season. Two were collected.

147. **Ducula badia.** Hodgson's Imperial Pigeon.

Large numbers were seen on the outer ranges between Selsemchi, 1,800 ft., and Lichi, 4,000 ft., where they were feeding on fruiting trees in heavy forest.

148. **Columba pulchricollis.** Ashy Woodpigeon.

Dafla name : *Pukurr.*

Occurs in the high-level evergreen forest between the Pein Valley and the Apa Tani Plateau. I shot one out of a small flock in pine trees at Soro, 6,000 ft. It is a silent and sluggish bird.

149. **Chalcophaps indica.** Emerald Dove.

Widely spread all over the hills, but nowhere common.

150 **Streptopelia orientalis orientalis.** Rufous Turtle Dove.

Generally not common. Seen occasionally in pairs in paddy fields and woodland patches on the Pein Valley down. Much more numerous in the Apa Tani Valley where they feed in the cultivation and breed in the pine plantations. Their numbers are greatly augmented after the harvest when there is a big influx to glean the stubbles.

151. **Streptopelia chinensis suratensis.** Indian Spotted Dove.

Found in the gardens round Dafla villages, but not common.

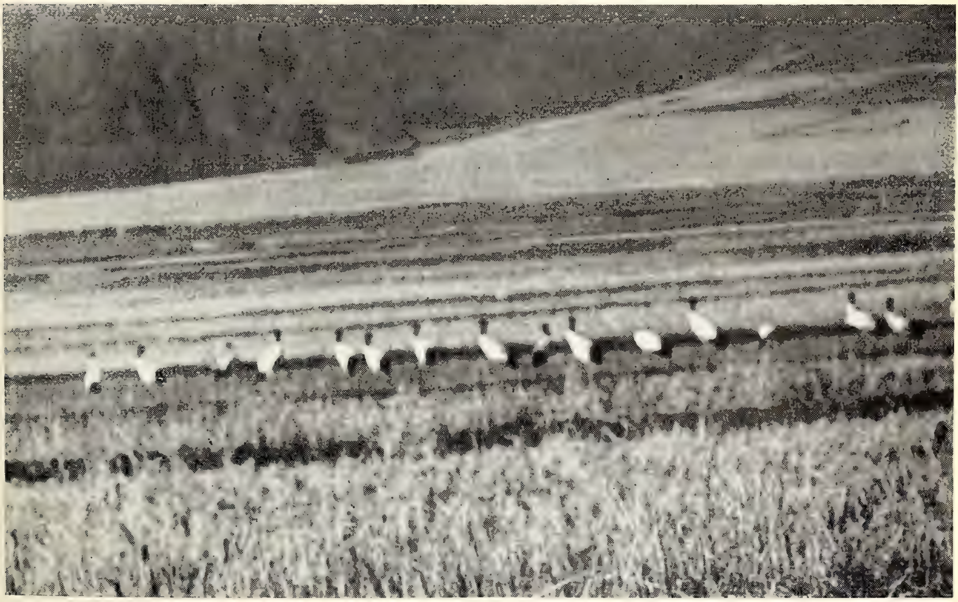
152. **Macropygia unchall.** Bartailed Cuckoo Dove.

Seen at Kore, 5,000 ft. They were resident but not numerous and were unobtrusive, haunting nullahs choked with secondary jungle, and feeding much on the ground. The specimen I shot had its crop stuffed with small black berries. They ascend the highest hills at certain times of year and I encountered flocks on top of Donko Puttu, 7,000 ft.

153. **Polyplectron bicalcaratum.** Peacock Pheasant.

Only encountered on the outer range from plains level up to the summit of Tasser Puttu, 4,000 ft., in heavy evergreen forest.

The Apa Tani Valley. Young plantation of *Pinus excelsa* in foreground



Blacknecked Cranes on Apa Tani paddy stubbles.

*(Photos: F. N. Betts)*

154. **Gallus bankiva.** Common Red Junglefowl.

Occurs everywhere throughout the hills, though nowhere numerous as it is much hunted by the Daflas.

155. **Gennaeus horsfieldii.** Blackbreasted Kalij Pheasant.

Occurs though not in large numbers all over the hills.

156. **Arborophila torqueola torqueola.** Common Hill Partridge.

A specimen was obtained, but the locality not recorded.

157. **Grus nigricollis.** Blacknecked Crane.

A flock of 30–40 of these Cranes winter annually in the Apa Tani Valley, arriving in mid-December and leaving in March. They frequent the open paddy stubbles and marshy fields and are extremely wary of anyone except the Apa Tani villagers who never harm them. Their numbers appear to be very constant and the villagers informed me that they had been coming every year within human memory. A male was shot for identification.

158. **Vanellus vanellus.** Lapwing.

A flock was seen on the fallow fields near Duta in the Apa Tani Valley on 2-12-47 and a specimen was shot.

159. **Tringa ochropus.** Green Sandpiper.

A fairly common winter visitor to the Apa Tani Valley.

160. **Tringa hypoleucos.** Common Sandpiper.

A winter visitor found along the Panior River and other large streams and rivers at all elevations. Usually seen singly.

161. **Capella gallinago.** Fantail Snipe.

Numerous in the swamps and fallow paddy fields of the Apa Tani Valley in winter.

162. **Phalacrocorax fuscicollis.** Indian Shag.

Often seen on the Panior River as a wanderer from the plains.

163. **Butorides striatus.** Little Green Heron.

Occasionally seen usually solitary on the Panior River.

164. **Anser indicus.** Barheaded Goose.

A visitor to the Apa Tani Valley on the spring passage, but not seen in the autumn. They are not seen in large flocks but two or three birds at a time may rest for several days in the fallow paddy fields.

165. **Casarca ferruginea.** Ruddy Shelduck.

The remarks under the last species apply to this one also.

166. **Anas crecca.** Common Teal.

167. **Spatula clypeata.** Shoveller.

Visitors to the Apa Tani Valley on passage. Specimens of both species were shot on the Kale River on 2-12-47.

168. **Aythia ferina.** Common Pochard.

A male was captured alive in the Apa Tani Valley on 30-10-47. It was on migration and very exhausted.

169. **Mergus merganser.** Goosander.

Fairly common in winter on the Panior and other large rivers of the area.

170. **Podiceps cristatus.** Great Crested Grebe.

A bird on passage was caught alive in the Apa Tani Valley in April in a very exhausted condition.

# NOTES ON THE HETEROCERA OF CALCUTTA

BY

D. G. SEVASTOPULO, F.R.E.S.

## PART I

The following notes are based on series in my collection caught in Calcutta between 1930 and 1946 and, from 1945 to 1946, on records of monthly occurrences. Specimens were obtained by breeding, by attraction to light, and by beating herbage and shrubs. Unfortunately the use of Mercury Vapour light was not introduced until after I had left India for good ; I am certain that its employment in Calcutta would have added considerably to the following lists.

The following figures, supplied by the Alipore Meteorological Station, are interesting :

| | Temperature | | Percentage Relative Humidity (mean of hourly values) | Total Rainfall in inches (average) |
|---|---|---|---|---|
| | Maximum (mean) °F | Minimum (mean) °F | | |
| January ... | 79·6 | 54·6 | 73 | 0·37 |
| February ... | 83·7 | 59·4 | 69 | 1·17 |
| March ... | 92·5 | 68·8 | 68 | 1·36 |
| April ... | 96·8 | 75·5 | 71 | 1·75 |
| May ... | 95·6 | 77·5 | 74 | 5·49 |
| June ... | 92·4 | 78·6 | 81 | 11·69 |
| July ... | 89·5 | 78·6 | 85 | 12·81 |
| August ... | 89·0 | 78·3 | 86 | 12·92 |
| September ... | 89·9 | 78·0 | 86 | 9·95 |
| October ... | 89·2 | 73·8 | 82 | 4·48 |
| November ... | 84·2 | 63·7 | 76 | 0·81 |
| December ... | 79·4 | 55·0 | 72 | 0·18 |

I have followed the Fauna of British India (Hampson, i–iv and Bell and Scott, v) as regards nomenclature as these books are fairly easily available.

### SATURNIIDAE

**Actias selene** Hbn.—I have included this species, although I have never met it personally, on the assurance of several non-entomological friends that they had seen it. It is quite unmistakable and could not be confused with anything else.

### BOMBYCIDAE

**Ocinara varians** Wlk.—Common throughout the year, both nominotypical and f. *albicollis* Wlk. Larva on peepul and other *Ficus* spp.

## EUPTEROTIDAE

**Eupterote undata** Blanch—Fairly common in vi, I have no record for any other month. The very hairy, very slow-growing larva appears to be polyphagous.

**E. geminata** Wlk.—Common from v to ix. The larva is gregarious, feeding on various trees and shrubs, and its hairs cause an intense irritation when they come in contact with the human skin.

## SPHINGIDAE

**Acherontia lachesis** F.—Fairly common from viii to xi. Eggs can be found on *Jasminum sambac.*

**A. styx** Westw.—Fairly common in all months except i, ii, v and xii. Eggs on *Jasminum sambac.*

**Herse convolvuli** L.—Common, recorded in i, ii, ix, x and xi. Larvae on Convolvulaceae spp.

**Cephonodes hylas** L.—Common at flowers in sunshine. Recorded for ii, iii, v, viii, xi and xii. Larvae common on *Gardenia.*

**Deilephila nerii** L.—Common, recorded for all months except iii, iv and x. Larvae common on oleander.

**D. hypothous** Cr.—A single male in vii.

**Nephele didyma** F.—Common, also f. *hespera* F. Recorded for iii, iv, vi and viii. Larvae on *Carissa carandas* (Apocynaceae).

**Macroglossum gyrans** Wlk.—Uncommon at flowers in sunshine. Recorded for iii and iv.

**M. affictitia** Btlr.—Uncommon at flowers in sunshine. Recorded in v.

**M. belis** L.—Fairly common at flowers in sunshine. Records for viii and ix.

**M. sitiene** Wlk.—Rare at flowers in sunshine. Recorded in iv.

**Hippotion celerio** L.—Common. Records for i, x, xi and xii.

**H. echeclus** Bsd.—Fairly common. Records for x and xi.

**H. boerhaviae** F.—Common. Records for i, v, vii, ix, x and xi.

**Theretra nessus** Drury—Fairly common. Recorded for x only.

**T. clotho** Drury—Common. Records for vii to xi.

**T. latreillei** Mac., **lucasi** Wlk.—A single male in x.

**T. alecto** L.—Uncommon. Records for ii and v.

**T. oldenlandiae** F.—Common, recorded in vii, viii, ix and xi. Larvae common on arums and very varied.

**T. pinastrina** Mart.—Common. Recorded from viii to xi. Larvae common on cultivated balsam and very conspicuous.

**Rhyncholaba acteus** Cr.—Common. Recorded from vii to x. Larvae very common on *Caladium* and other arums.

## NOTODONTIDAE

**Turnaca acuta** Wlk.—Rare. Recorded in viii and ix.

**Antheua servula** Drury—A single female in vi.

**Stauropus alternus** Wlk.—Bred in iii from larvae found on *Cassia fistula* and castor.

**Ichthyura restitura** Wlk.—A single male in ii. Now *Pygaera.*

**I. ferruginea** Moore—A single female in vi. Now *Pygaera.*

## SYNTOMIDAE

**Syntomoides imaon** Cr.—Common. Recorded from i to iv. Now *Ceryx.*

**Syntomis cyssea** Cr.—Common. Records for i, ii, iii, iv, viii and xi. Now *Amata.*

**S. passalis** F.—Fairly common. Records for vi, viii, ix and x. Now *Amata.*

**S. confinis** Wlk.—Fairly common. Records for ii, v and vi. Now *Eressa.*

## ZYGAENIDAE

**Thyrassia subcordata** Wlk.—Two females. Recorded in vii.

**Trypanophora semihyalina** Koll.—Not uncommon. Records for i, ii, iii and xi. Larvae on many shrubs.

**Chalcosia thallo** L.—Rare, recorded in xi. Now *auxo* L.

## PSYCHIDAE

**Clania crameri** Westw.—Fairly common. Bred in i, v and vi.

**C. variegata** Snell.—A single male at light in i.

**Amatissa cuprea** Moore—Fairly common. Bred in x.

**Psyche fusca** Hamps.—Two males at light in xi.

**Chalioides vitrea** Hamps.—Fairly common. Bred in vi and vii.

### COSSIDAE

**Cossus acronyctoides** Moore—Rare. Recorded in vi and viii.

**C. cadambae** Moore.—A single female in iii.

**Duomitus leuconotus** Wlk.—A single female in ii. Pupa cases of what I think are this species quite common protruding from trunks of *Cassia fistula.* Now *Xyleutes.*

**Azygophlebs scalaris** F.—Uncommon. Recorded in vii and xi.

**Zeuzera coffeae** Nietn.—A pair recorded in x.

### ARBELIDAE (now INDARBELIDAE)

**Arbela quadrinotata** Wlk.—Not uncommon. Recorded in iv. Now *Indarbela.*

### DREPANULIDAE (now DREPANIDAE)

**Phalacra vidhisara** Wlk.—Uncommon. Recorded for iii and xii.

**Drapetodes mitaria** Guen.—Two females in xii.

### THYRIDIDAE

**Striglina scitaria** Wlk.—Not uncommon. Recorded in i and x. Larva on *Phaseolus* sp.

**Rhodoneura myrsusalis** Wlk.—Fairly common. Recorded in vi, x and xi.

### LIMACODIDAE

**Thosea cana** Wlk.—One female bred from a larva from *Cassia fistula* in ix.

**T. tripartita** Moore—Common, recorded in iv and vi to x. Larvae on *Ricinus communis* and *Zizyphus jujuba.*

**T. loesa** Moore—Uncommon, recorded in viii and xi. Larvae on areca palm.

**T. cervina** Moore—Fairly common, records for v, vi, viii and ix.

**Natada nararia** Moore—Bred in i, iii and x from larvae found on *Lagerstroemia indica.* Now *Macroplectra.*

**Parasa lepida** Cr.—Very common. Recorded from v to x. Larvae common on mango and less so on *Gardinia.*

**P. hilaralis** Westw.—Bred from larvae on an unidentified food-plant in ii and x.

**P. bicolor** Wlk.—Uncommon. Recorded in v and vi.

**Cania bilinea** Wlk.—Not uncommon. Records for vi, viii, x and xii.

**Altha nivea** Wlk.—Common, records for viii, ix and xi. Larvae on *Tinospora cordifolia.*

**Narosa doenia** Moore—A number bred in iii and iv from larvae found on *Ricinus communis.*

## LASIOCAMPIDAE

**Taragama siva** Lef.—Common. Recorded in ii, iii, iv, v, ix and x. Now *Nadiasa.*

**Metanastria hyrtaca** Cr.—Common. Recorded in all months except iv, ix and x. Larva on *Mimusops elengi* (Sapotaceae).

**Trabala vishnu** Lef.—Very common. Recorded for all months except ii, iii, ix and x. Larvae on various plants.

**Estigena pardalis** Wlk.—Common. Recorded in i, ii, iii, vi, x, xi and xii. Larvae on *Carissa carandas.*

## LYMANTRIIDAE

**Orgyia postica** Wlk.—Fairly common. Recorded in i and ix. Larvae on *Lagerstroemia indica.*

**Aroa plana** Wlk.—Uncommon. Records for ix and xii.

**Laelia exclamationis** Koll.—Bred from larvae found on coarse grass in x.

**Dasychira mendosa** Hbn.—Common. Records for i, ii, iii, xi and xii. Male forms *divisa* Wlk., *basalis* Wlk. and an unnamed one in addition to the nominotypical. Larvae on *Lagerstroemia indica*, all with grey dorsal tufts. I have never seen the yellow-tufted form described by Hampson.

**D. securis** Hbn.—Not very common. Only record for viii. Larvae on coarse grass. I have found it very delicate in captivity. Now *Psalis pennatula* F.

**Lymantria ampla** Wlk.—Very common, records for all months except iv, vii and viii. Males assemble freely to the wingless females. Larvae on many plants, *Crotalaria*, *Lagerstroemia indica*, mango, palms and many others.

**L. nigra** Moore—Common. Records for ii, iv, viii, ix, x, xi and xii. Larvae on Mango. Hampson's omnibus species *beatrix* Stoll. has been split up into several.

**L. obsoleta** Wlk.—Common. Recorded for all months except v, ix and xii.

**Euproctis subfasciata** Wlk.—Uncommon. Records for iii and vi. Larvae on *Quisqualis indica.*

**E. bimaculata** Wlk.—Uncommon. Records for iv, vi, ix, x and xii.

**E. lunata** Wlk.—Uncommon. Records for ii, iii and x. Larvae on *Carissa carandas.*

**E. howra** Moore—Common. Recorded in i, vii, ix and xi.

**E. flavinata** Wlk.—A single male in vi.

**E. varians** Wlk.—Common. Records for i and ii.

**E. guttata** Wlk.—Common. Records for i, iii, vii, viii and x. Larvae on *Lagerstroemia indica, Carissa carandas* and *Zizyphus jujuba.*

**E. fraterna** Moore—Common. Records for ii, iv and v.

**E. plana** Wlk.—Uncommon. Records for i and x.

**E. discinota** Moore—Uncommon. Recorded in xii only.

**E. scintillans** Wlk.—Very common. Records for i, iii, viii, ix, x, xi and xii. Larvae on many shrubs and also on Sunflower. Now *Porthesia.*

**Porthesia xanthorrhoea** Koll.—Common. Records for vii, ix and xi. Larvae on *Lagerstroemia indica,* also recorded on maize, Jowar and other Monocotyledons.

**Perina nuda** F.—Common, the males fly by day and the females come to light. Recorded for all months of the year. Larvae on *Ficus* spp.

**Leucoma submarginata** Wlk.—Common. Recorded for i, x, xi and xii. I have two unnamed *Leucoma* species from larvae found on *Lagerstroemia flos-reginae.*

## ARCTIIDAE

**Hypsa paphos** F.—A single male in ii. Now *Asota.*

**H. caricae** Bsd.—Common. Records for i to iv and ix to xii. Larvae on *Ficus* spp. Now *Asota.*

**H. ficus** F.—Common. Recorded from v to ix. Larvae on *Ficus* spp. Now *Aganais.*

**Digama hearseyana** Moore—Not uncommon. Recorded for x only.

**D. insulana** Fld.—A single female in ii.

**D. marchali** Guer.—A single female in x.

**Spilosoma obliqua** Wlk.—Common, records for i, ii, iv, ix, x, xi and xii. Larvae on numerous low plants. Hampson's *dalbergiae* Moore is a form of this species, with yellow abdomen instead of red.

**Pericallia ricini** F.—Common. Recorded from iv to xi. A single male of the yellow hind-winged form *zerah* Cr. Larvae on castor and many low plants. Hampson calls this *Arctia.*

**Creatonotus interruptus** Gmel.—Common. Recorded in vii, viii, ix and xi. Now *gangis* L.

**C. emittens** Wlk.—Common. Recorded from viii to xi. Now *Amsacta lineola* F.

**Phissama transiens** Wlk.—Common. Records for ii, iii, iv, vii, viii, ix and x. Larvae on grasses. Now *Creatonotus.*

**Pelochyta astrea** Drury—A single female in iv. Now *Rhodogastria eugenia* F.

**Argina cribraria** Clerck—Fairly common. Records for iv, vii, viii and x.

**Deiopia lotrix** Cr.—Common. Recorded in iii, iv, vi, vii, x and xi. Larvae will feed on dahlia but the natural food is *Heliotropium indicum.* Now *Utetheisa.* Hampson treats *lotrix* as a form of *pulchella* L.

**Utetheisa pulchelloides** Hamps., **vaga** Jord.—Common. Records for iii, iv and vi. Found amongst its food-plant *Heliotropium indicum.* The Fauna omits this species.

**Lithosia natara** Moore—Common. Recorded from ix to xii.

**L. auriflua** Moore—Uncommon, records for x and xi. Apparently this species in spite of Hampson's localities of Kulu and Manipur.

**L. pentaspila** Hamps.—A single female in xi. The Fauna omits this species.

**Aemene guttulosana** Wlk.—Common. Recorded in viii, x, xi and xii. Now *Siccia.*

**Siccia minima** Hamps.—Not uncommon. Recorded from ix to xii. Not included in the Fauna.

**Trischalis dulcicula** Swinh.—Not uncommon. Records for i, x, xi and xii. Now included in *Hemonia.*

**Miltochrista rubricosa** Moore—Common. Recorded in i, ii, vi, vii, ix, x and xi. Now *Asura.*

**M. congerens** Feld.—Uncommon. Records for x, xi and xii. Now *Asura.*

**Thumatha fuscescens** Wlk.—Not common. Records for vii, x and xi.

**Schistophlebs bipuncta** Hamps.—Common. Recorded in i, x, xi and xii.

**Chamaita trichopteroides** Wlk.—A single male in x. This species is omitted from the Fauna.

**Nola fragilis** Swinh.—Common. Records for i, ii, iii, x and xi. Now *Celama taeniata* Snell.

**N. pascua** Swinh.—Common. Recorded in i, ii, iii, iv, x, xi and xii. Now *C. internella* Wlk.

**Celama cretacea** Hamps.—A single female in v. Not in the Fauna.

**Nola major** Hamps.—Fairly common. Records for iii, iv, vi, x, xi and xii.

**N. fuscibasalis** Hamps.—Bred from larvae found on *Zizyphus jujuba* in xi. Not in the Fauna.

**Roeselia fola** Swinh.—Bred from larvae found on *Quisqualis indica* in xi. Not in the Fauna.

**Zia ectrocta** Hamps.—Common. Recorded from vii to xii. Not in the Fauna.

(*to be continued*)

# INDIAN MARSILEAS: THEIR MORPHOLOGY AND SYSTEMATICS

## 1. *MARSILEA AEGYPTIACA* WILLD. WITH REMARKS ON THE PRESENT SYSTEMATIC POSITION OF INDIAN SPECIES

BY

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*Jaswant College, Jodhpur*

(*With* 3 *plates and* 8 *text figures*)

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### INTRODUCTION

The presence of a new type of *Marsilea* was suspected by the senior author in October 1953, in the aquatic flora of Jodhpur. Its reference to the Director, Royal Botanic Gardens, Kew, confirmed that suspicion and Mr. F. Ballard, the expert Pteridologist there, identified it as *M. aegyptiaca* Willd. A brief note on the occurrence of this Egyptian species in the Indian flora was then sent for publication in the *Journal of the Bombay Natural History Society* (Gupta, 1955).

The genus *Marsilea* was founded by Linnaeus and named after Count Luigi Ferdinando Massigli (1737); whereas Willd. now instituted the new species *M. aegyptiaca* in 1810 on the material collected from lower Egypt. The earliest collections of this species at Kew date as far back as 1819 and 1826, while in India the oldest specimens at Calcutta Herbarium were collected in 1835. Pl. 3, fig. 17 shows a specimen collected by J. Schweinfurth from Tel-el-Kebir (lower Egypt) in 1880, and presented to the senior author by the authorities of the Kew Herbarium.

As far as we know, no detailed descriptions on the morphology of *M. aegyptiaca* have been published; but there are some references to its anatomy in the work of Russow (1872) and on its gametophytes by Campbell (1888). Unfortunately these are not yet available to us for consultation. Besides these, the original descriptions of

*M. aegyptiaca* are very brief and are only of the nature of diagnoses such as the following:

(*a*) Boiss. *Flor. Or.* 5: 750 (1884). *Marsilea aegyptiaca* (W. Sp. W. Sp. V, p. 540) ad petiolos et laminam pilosa saepe glabrata, frondis segmentis anguste cuneatis emarginatis bilobis vel interdum 3-6-lobis, in formis natantibus apice rotundatis indivisis, sporocarpiis singulis stipite eis multo longiore a petiolo libero suffultis horizontaliter deflexis adpresse hirsutis obtuse tetragonis apice subretusis latere dorsali sulcatis angulo basali unidentatis, adpresse pilosis tandem glabratis ic. Del. Fl. Eg. tab. 56.

Hab. in totius Egypti aquis profundis et inundatis tandem exsiccatis (Del. Schimp! Boiss! Schweinf! etc.)

Forma ex locis tandem exsiccatis petiolos breviores habet, segmenta minuta et apice lobata, haec sola fructificat. In aquis profundis autem crescit forma sterilis petiolis saepe longissimis, segmentis multo majoribus et apice rotundatis integris *M. quadrifoliae* similis.

(*b*) Baker. *Handbook of Fern Allies* p. 145 (1887) 30. *M. aegyptiaca* Willd. Sp. V. 540; Delile, Fl. Egypt. 253, t. 50—Subterrestrial or aquatic, very variable in size. Petiole in the aquatic form ½-1 ft., leaflets deltoid, ½-¾ in. long, entire; in the sub-terrestrial form much shorter; leaflets ¼-½ in. long, often thinly silky, deeply crenate on the outer edge. Pedicels solitary, erect, ¼-⅓ in. long, adnate to the whole base of the conceptacle which is horizontal, nearly square, 1-12th to 1-10th in. long, usually silky, not bordered, with the upper corner of the base produced into an obscure tooth. Sori about 6.

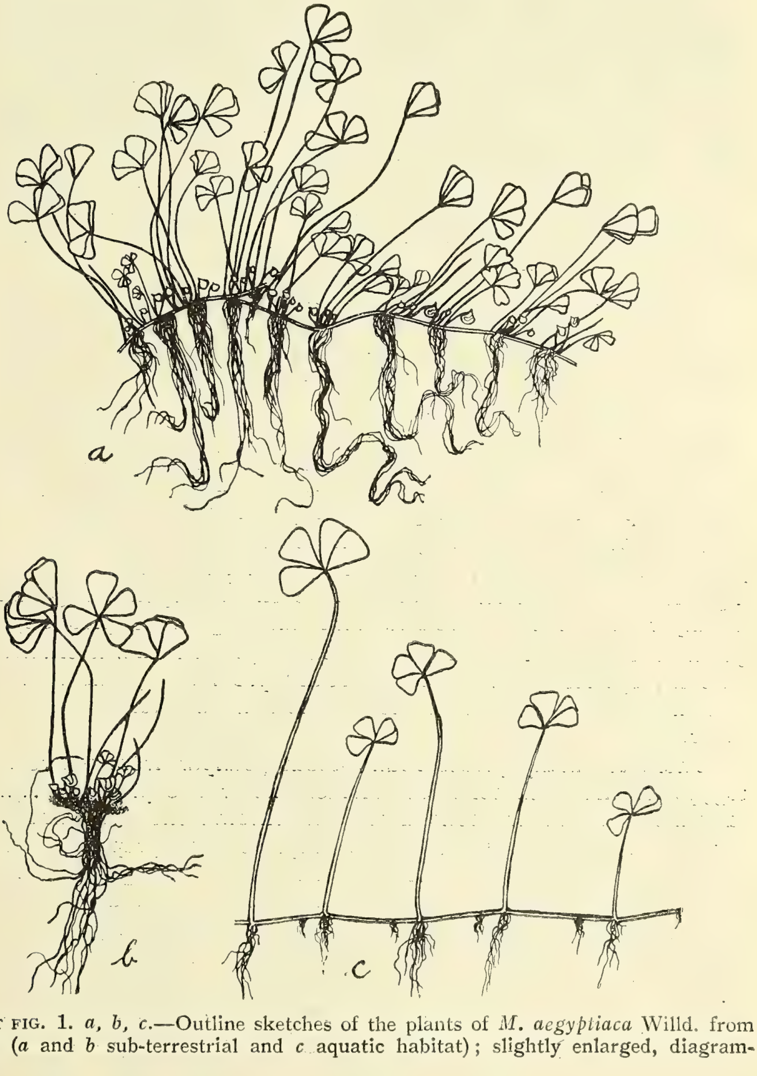
Hab. Lower Egypt and Astrakhan.

## MORPHOLOGY

### General

Under the circumstances it was thought worth while to undertake the morphological investigation of this species, particularly when it was locally available. It may be mentioned that two other well-known species of *Marsilea*, *M. minuta* and *M. quadrifolia*, also occur abundantly in various parts of Rajasthan (see map, text fig. 3) but *Marsilea aegyptiaca* has so far been collected only in Jodhpur and Jaisalmer besides Ajmer. The possibility of its still wider distribution in Rajasthan is not ruled out. A closely related species, *M. condensata* Baker occurs in Sind. A new species, *M. ballardii*, has now been reported by the senior author from Ajmer (Gupta, 1955).

As usual with the genus, the habit of the plants of *M. aegyptiaca* varies according to the nature of the habitat. They flourish well both in water and on land. The dorsiventral rhizome gets very much condensed in sub-terrestrial or terrestrial surroundings, producing solitary squarish sporocarps profusely (text fig. 1 *a* & *b*; Pl. 1, fig. 1). The external features of the vegetative organs resemble essentially those found in other Indian species like *M. minuta* and particularly so when the same are compared with plants of the latter species that may be growing in a sub-terrestrial habitat. Some sterile plants of *M. minuta* collected by the senior author from a terrestrial habitat in Bharatpur were almost indistinguishable from those of *M. aegyptiaca*. If sporocarps were available, the identity of the two species could, of course, be determined at once. The plants of *Marsilea* are notorious in exhibiting morphological plasticity under different environmental conditions and present quite a different appearance according to the season. It is not uncommon to observe plants with different types of leaves on the same rhizome that may be partly submerged and partly growing in the muddy margins of the aquatic habitat. In *Marsilea aegyptiaca* the lengths of the internodes,



TEXT FIG. 1. *a, b, c.*—Outline sketches of the plants of *M. aegyptiaca* Willd. from Jodhpur (*a* and *b* sub-terrestrial and *c* aquatic habitat); slightly enlarged, diagrammatic.

for instance, vary so greatly that a correlation of size and habitat was almost impossible. On the basis of some ecological studies made by the junior author, it was found that the size of the roots, petioles and leaflets vary from 0.63 cm. to 9.52 cms., 0.93 cm. to 11.43 cms. and 0.25 cm. to 1.52 cms. respectively. Similarly a size ratio between the length of the pedicels and the sporocarps was worked out. It was found that the pedicel was three or four times the size of the sporocarp. Not only this but the sporocarps being almost squarish, the stalks are naturally three or four times the breadth of the sporocarps too. This fact may be of some real significance for the species and, if such a ratio were to be established in any other form of *Marsilea,* the affinities of the two will have to be reckoned with. As far as our observations go, no such relationship is noticeable in any other species, much less in the Indian species except to some exent in *M. condensata* Baker or *M. ballardii* Gupta.

The study of external morphology shows that growing parts such as the tips of rhizomes, petioles and young sporocarps are densely covered with hairs. These hairs are longer in size and consist of more numerous cells than those which are present on the older parts such as the ripe sporocarps. It is not uncommon to see that the average size of the individual cells of these hairs too is also bigger in those hairs which are found on the younger parts. For instance the average number of cells constituting the hairs on the apex of the rhizome, petiole, leaf, young sporocarp and old sporocarp is 10, 4, 4, 5, 3, respectively. It may be indicated that such features might provide additional data, though of a subsidiary nature, in distinguishing the various species of *Marsilea* even on vegetative grounds. It is important when we realize that the vegetative plasticity of the genus is so variable. Of course, the diagnostic characteristics of the different species of *Marsilea* are really provided by the sporocarp, a fact that will be clear from the descriptions that follow in the present paper.

There are many places round about Jodhpur from where *Marsilea aegyptiaca* has been collected, besides one or two places in Ajmer and Jaisalmer. Formalin-acetic-alcohol or chromacetic acid was used as fixative and usual methods were employed for preparing free hand as well as microtome sections. Safranin and fast-green combination gave quite satisfactory results. In order to study the vascular anatomy of the nodal region as well as the sporocarps, Debenham's technique of clearing entire organs was tried with success. This consists in treating plant organs with 70-75% lactic acid at 50°-60°C. for at least two weeks, then bleaching the material with Eau-de-Javelle at 40°C. and finally staining the material with ammoniacal fuchsin for at least three days. After the usual dehydration process they were mounted in Canada balsam for examination. Sporocarps were kept for softening in hydroflouric acid for about three weeks for all microtome work before sectioning. 10-12 micron thick sections were found quite satisfactory for all anatomical and morphological study. In order to take out the vascular skeleton of the sporocarps, the latter were treated for about 20 minutes with concentrated nitric acid.

## Vegetative Organs

*Root*: Roots are all adventitious. They arise in groups at the nodes from the ventral side of the rhizomes; sometimes they may arise in the internodal region. These are much longer and thinner in the sub-terrestrial plants than those produced under aquatic conditions and differ markedly in their colour: brownish when growing in the soil and whitish when in water (text fig. 1. *a, b, c*). Anatomically, the root is typically diarch with a thick inner cortex and a lacunar outer cortex (Pl. 2, fig. 10). We are unable to follow exactly what Puri and Garg mean by the statement 'Root traces are protostelic' in *M. minuta* (p. 190, 1953). As far as we know this term is used in describing a simple stele, namely solid xylem surrounded by phloem in a rhizome.

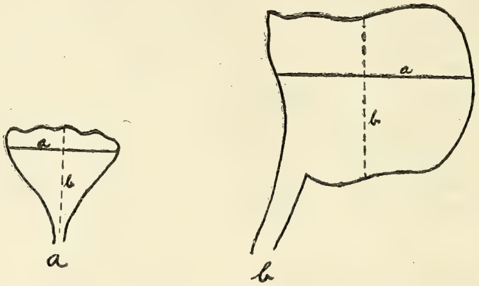
*Stem*: The rhizome is dorsiventral and creeps along the ground, producing nodes and internodes. The latter become much too short under sub-terrestrial conditions giving the plant a tufted appearance (Pl. 1, fig. 1). It branches in a dichotomous manner and is able to grow indefinitely covering larger surface under aquatic conditions, although the root system penetrates much deeper in sub-terrestrial plants. The leaves are produced at the nodes alternately, so also the roots in small numbers on the lower side of the rhizome.

A bud is usually associated with a leaf and placed adaxially in the lateral or oblique position indicating, as Bower says, the dichotomy of the axis with somewhat unequal division of the two shanks. Under comparatively dry conditions solitary squarish sporocarps are produced at the base of the leaves.

There is no serious departure from the other species in the anatomy of the rhizome. It possesses an amphiphloic siphonostele (Pl. 2, fig. 9). The protoxylem is distinctly mesarch and it is unlikely that it should be exarch in a fern stem. The statement that there are prominent masses of conspicuous protoxylems in the exarch position in *M. vestita* (Smith, p. 328) may not necessarily mean that the very first elements produced occupy such a position as to allow the subsequent development of the entire metaxylem centripetally. At any rate this is not the case in *M. aegyptiaca*, although the anatomy has not yet been thoroughly studied by means of longitudinal sections. The pith is sclerotic and the lacunar area much smaller in the terrestrial forms. The branching of the rhizome in a dichotomous manner, the development of the leaf on the node and the origin of the peduncle further at the base of the petiole can be clearly seen in a transverse section of the nodal region.

*Leaf*: The leaves are produced laterally from the dorsal side at the nodes of the rhizome and remain floating in aquatic plants and almost erect in the sub-terrestrial habitat. The leaf petioles in the aquatic plants are thicker and flexible, whereas in the land forms these are thinner, smaller and more rigid, keeping the leaflets spreading by assuming an acute angle on the rhizome. There are four leaflets produced in two successive stages, first the proximal pair separates and then the distal pair. A section passing through the circinately coiled young leaf demonstrates this quite clearly. The venation of the leaflets is typically furcate, though the presence of the connecting marginal vein makes it a simple reticulum.

The petiolar anatomy is quite typical of the genus (Pl. 2, fig. 11); but some points of interest have been noted in the structure of the leaflets of plants growing in different habitats. The palisade, the mesophyll, the vascular bundle, the nature of the epidermis as well as the presence of stomata on the upper surface only in the aquatic and on both surfaces in the land forms (Pl. 2, fig. 7) are points worth noting. The epidermal cells in *M. aegyptiaca* are quite large with sinuous outline and the stomata are irregularly distributed though facing in the same direction. Every stoma is usually bounded by three epidermal cells which are placed along the length of the guard cells and the stomatal opening (Pl. 2, fig. 8). Some of the measurements of the vegetative organs taken during an ecological study (Bhardwaja, 1955) of *M. aegyptiaca* have been mentioned in Table I.



TEXT FIG. 2. Diagrammatic representation of the leaf (*a*) and the sporocarp (*b*) to indicate the relation of *a*/*b* as noted in the Table I given below.

## The Sporocarp

The disposition of sporocarps as well as their grouping is of value as referred in the later part of the present paper under systematic consideration; so also is their internal and external morphology important from the point of view of classification of the genus *Marsilea*. Enough stress does not seem to have been laid in the past on the characters of the sporocarps in spite of the fact that vegetative features in a plant like *Marsilea* may prove to be very deceptive for diagnostic purposes. It will be seen from the descriptions of *M. aegyptiaca* as embodied in the present work that the structure of the sporocarp here is so different from that described for any other species so far that its identity can hardly be mistaken, at least from any other Indian species.

*External features*: The stalked sporocarps are borne singly at the base of the petioles (text fig. 1. *a*) and usually produced at the end of the wet season (November and December) when the water is receding from the margin of the tanks. But a much larger number is produced in comparatively dry weather when plants begin to live in subterrestrial or terrestrial habitat. Due to the extreme decrease in the size of the internodes of the rhizomes and greater production

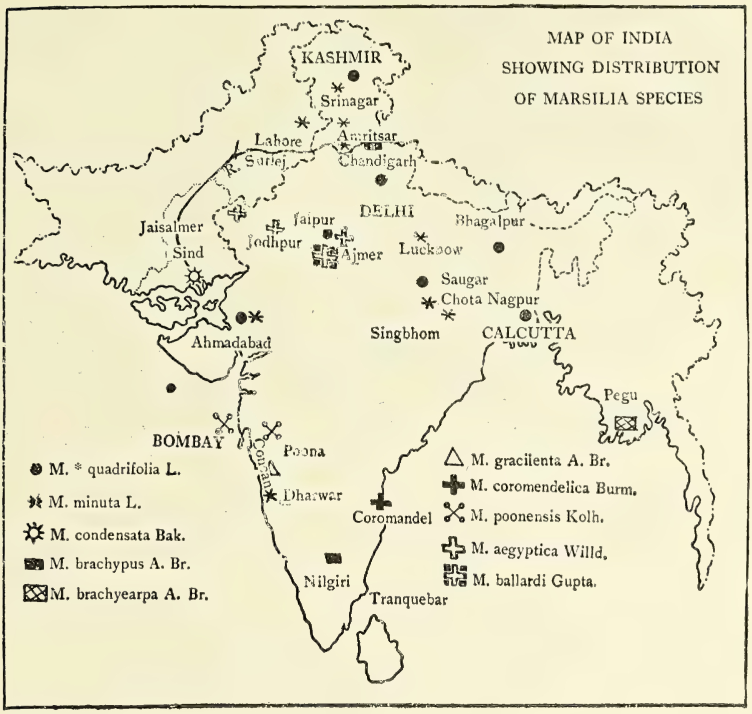
Measurements of some vegetative and reproductive organs of *M. aegyptiaca* Willd. from two different places in Jodhpur.

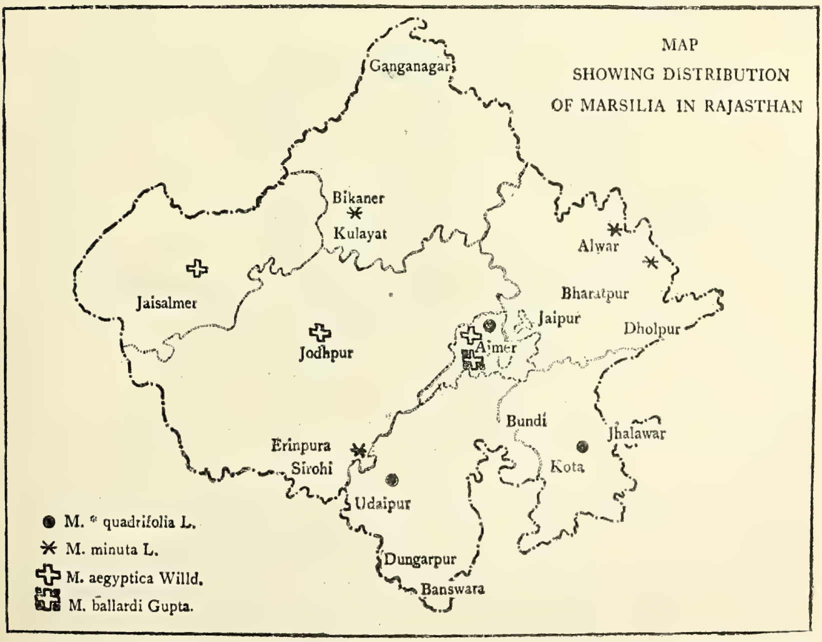
1. LALSAGAR

| Plant No. | Habit. | | Root | Petiole | Leaflets a/b | Pedicel | Sporocarps | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1. | Subterrestrial. | Average ... | 4·19 cm. | 3·63 cm. | $\frac{0·81}{1·09}$ cm. | 0·45 cm. | $\frac{0·22}{0·22}$ cm. | ... |
| | | Maximum ... | 5·38 ,, | 6·65 ,, | $\frac{1·52}{1·77}$ ,, | 0·63 ,, | $\frac{0·30}{0·30}$ ,, | ... |
| | | Minimum ... | 2·69 ,, | 1·90 ,, | $\frac{0·25}{0·50}$ ,, | 0·30 ,, | $\frac{0·05}{0·05}$ ,, | ... |
| 2. | Subterrestrial. | Average ... | 4·67 ,, | 3·93 ,, | $\frac{0·66}{0·91}$ ,, | 0·45 ,, | $\frac{0·20}{0·20}$ ,, | ... |
| | | Maximum ... | 6·35 ,, | 4·44 ,, | $\frac{0·76}{1·01}$ ,, | 0·63 ,, | $\frac{0·30}{0·30}$ ,, | ... |
| | | Minimum ... | 2·54 ,, | 3·63 ,, | $\frac{0·50}{0·76}$ ,, | 0·30 ,, | $\frac{0·05}{0·05}$ ,, | ... |
| 3. | Aquatic. | Average ... | 2·03 ,, | 5·53 ,, | $\frac{0·50}{0·50}$ ,, | | | Sporocarps generally do not develop in aquatic habitat. |
| | | Maximum ... | 3·32 ,, | 10·16 ,, | $\frac{0·76}{0·76}$ ,, | ... | ... | |
| | | Minimum ... | 1·09 ,, | 0·78 ,, | $\frac{0·25}{0·25}$ ,, | | | |
| 4. | Aquatic. | Average ... | 2·46 ,, | 3·01 ,, | $\frac{0·53}{0·53}$ ,, | | | |
| | | Maximum ... | 5·08 ,, | 9·82 ,, | $\frac{0·76}{0·76}$ ,, | ... | ... | Do. |
| | | Minimum ... | 0·78 ,, | 0·93 ,, | $\frac{0·25}{0·25}$ ,, | | | |
| 5. | Aquatic. | Average ... | 1·67 cms. | 4·87 cms. | $\frac{0·45}{0·45}$ cms. | | | Sporocarps generally do not develop in aquatic habitat. |
| | | Maximum ... | 3·32 ,, | 8·25 ,, | $\frac{0·76}{0·76}$ ,, | ... | ... | |
| | | Minimum ... | 0·63 ,, | 1·27 ,, | $\frac{0·25}{0·25}$ ,, | | | |

II. Chhitar Palace

| Plant No. | Habit. | | Root | Petiole | Leaflets a/b | Pedicel | Sporocarps | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1. | Subterrestrial. | Average ... | 4·08 cm. | 5·38 cm. | $\frac{0\cdot60}{0\cdot86}$ cm. | 0·83 cm. | $\frac{0\cdot30}{0\cdot30}$ cm. | ... |
| | | Maximum ... | 0·93 ,, | 6·98 ,, | $\frac{0\cdot76}{1\cdot01}$ ,, | 0·93 ,, | $\frac{0\cdot30}{0\cdot30}$ ,, | ... |
| | | Minimum ... | 2·54 ,, | 3·47 ,, | $\frac{0\cdot25}{0\cdot54}$ ,, | 0·78 ,, | $\frac{0\cdot30}{0\cdot30}$ ,, | ... |
| 2. | Subterrestrial. | Average ... | 3·70 cm. | 3·17 cm. | $\frac{0\cdot60}{0\cdot86}$ cm. | 0·71 cm. | $\frac{0\cdot25}{0\cdot25}$ cm. | ... |
| | | Maximum ... | 5·38 ,, | 3·81 ,, | $\frac{0\cdot76}{1\cdot01}$ ,, | 0·78 ,, | $\frac{0\cdot30}{0\cdot30}$ ,, | ... |
| | | Minimum ... | 1·42 ,, | 2·54 ,, | $\frac{0\cdot50}{0\cdot76}$ ,, | 0·63 ,, | $\frac{0\cdot20}{0\cdot20}$ ,, | ... |
| 3. | Subterrestrial. | Average ... | 5·79 ,, | 3·60 ,, | $\frac{0\cdot86}{1\cdot11}$ ,, | 0·83 ,, | $\frac{0\cdot27}{0\cdot27}$ ,, | ... |
| | | Maximum ... | 9·52 ,, | 4·11 ,, | $\frac{1\cdot01}{1\cdot27}$ ,, | 1·09 ,, | $\frac{0\cdot30}{0\cdot30}$ ,, | ... |
| | | Minimum ... | 2·54 ,, | 2·54 ,, | $\frac{0\cdot50}{0\cdot76}$ ,, | 0·63 ,, | $\frac{0\cdot05}{0\cdot05}$ ,, | ... |
| 4. | Aquatic. | Average ... | 2·54 ,, | 5·08 ,, | $\frac{0\cdot50}{0\cdot50}$ ,, | | | Sporocarps generally do not develop in aquatic habitat. |
| | | Maximum ... | 4·57 ,, | 8·89 ,, | $\frac{0\cdot76}{0\cdot76}$ ,, | ... | ... | |
| | | Minimum ... | 1·01 ,, | 1·27 ,, | $\frac{0\cdot25}{0\cdot25}$ ,, | | | |
| 5. | Aquatic. | Average ... | 2·92 ,, | 6·22 ,, | $\frac{0\cdot63}{0\cdot63}$ ,, | | | |
| | | Maximum ... | 5·08 ,, | 11·43 ,, | $\frac{0\cdot86}{0\cdot88}$ ,, | ... | ... | do. |
| | | Minimum ... | 0·76 ,, | 1·01 ,, | $\frac{0\cdot35}{0\cdot35}$ ,, | | | |


MAP OF INDIA
SHOWING DISTRIBUTION
OF MARSILIA SPECIES
KASHMIR
Srinagar
Lahore
Amritsar
R. Sutlej
Chandigarh
Jaisalmer
Sind
Jaipur
Jodhpur
Ajmer
DELHI
Bhagalpur
Lucknow
Saugar
Chota Nagpur
Singbhom
CALCUTTA
Ahmadabad
Pegu
BOMBAY
Poona
Concan
Dharwar
Coromandel
Nilgiri
Tranquebar
● M. * quadrifolia L.
✱ M. minuta L.
M. condensata Bak.
M. brachypus A. Br.
M. brachyearpa A. Br.
△ M. gracilenta A. Br.
M. coromendelica Burm.
M. poonensis Kolh.
M. aegyptica Willd.
M. ballardi Gupta.

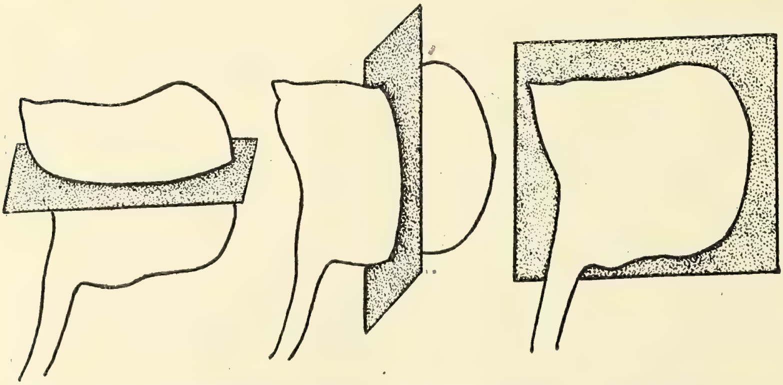

MAP
SHOWING DISTRIBUTION
OF MARSILIA IN RAJASTHAN
Ganganagar
Bikaner
Kulayat
Alwar
Bharatpur
Jaisalmer
Jodhpur
Jaipur
Dholpur
Ajmer
Bundi
Jhalawar
Erinpura
Sirohi
Kota
Udaipur
Dungarpur
Banswara
● M. * quadrifolia L.
✱ M. minuta L.
M. aegyptica Willd.
M. ballardi Gupta.

TEXT FIG. 3. Maps of India and Rajasthan showing the distribution of genus *Marsilea* as far as known to the authors.

of the sporocarps, the plants become tufted with bunches of sporocarps, of course, produced singly in the characteristic way of the species (Pl. 1, fig. 1). It is a common observation that amphibious forms living partly in water and partly on land usually produce fruiting bodies under dry conditions, e.g. species of *Riccia* such as *R. natans* and *R. fluitans*. May be this shows that *Marsilea* has acquired aquatic habit only secondarily.

The thin pedicel of the sporocarp arises laterally from the base of the petiole, grows at an angle bearing the sporocarp at its end where it becomes fully adnate to its base (Pl. 1, fig. 3). The lower horn is absent. The upper one is represented by a blunt one (Pl. 1, fig. 1). The young sporocarps are densely covered with adpressed hairs (Pl. 1, figs. 3 to 6); the older ones much less so. As already described (Gupta, 1955), the sporocarps are variously grooved, besides being squarish in outline (Pl. 1, figs. 3-5); so that in section they present an outline which may be quite characteristic of the species (Pl. 3, figs. 13 & 14). The most prominent external features of the sporocarp, therefore, in *M. aegyptiaca* are its squarish outline, presence of only one upper blunt horn, deep groove towards the left encasing the end part of the peduncle and prominent dorsal and ventral depressions (Pl. 1, figs. 3-5).

*Anatomy*: Our observations are based on a few sections of the adult sporocarps, the development in the young ones has not yet been studied. Free hand as well as microtome sections (about 10-12$\mu$. in thickness) were cut in all the three important planes namely horizontal, vertical transverse and vertical longitudinal as represented below (text fig. 4).

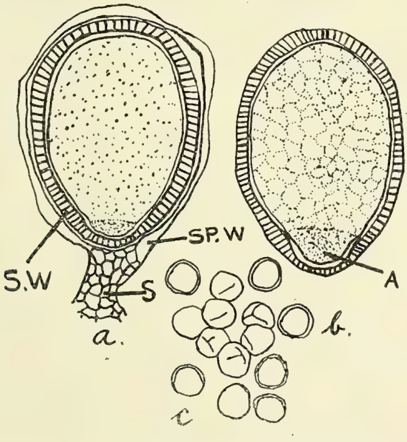


TEXT FIG. 4. Diagrammatic representation of the planes in which the sporocarp has been cut for anatomical studies.

The anatomy of the peduncle is similar to the petiole, although its vascular supply arises in the manner of a pinna trace from the petiole. It may be a modified fertile segment of the leaf or similar to the whole leaf, more probably the former. In *Marsilea aegyptiaca* the inner cortex of the peduncle is not only thick-walled but much wider than is usually found in other species (Pl. 2, fig. 12). The vascular bundle of the peduncle passes into the sporocarp without showing any sign of a branch or a hump for the horn. After giving two opposite branches on its entry into the sporocarp, this vascular trace of the peduncle gives out branches alternately and the latter in turn divide and anastomose to supply the entire wall of the sporocarp. Vascular supply is further given out from the ultimate branches to the placentae of the sori. The main vascular bundle of the sporocarp in transverse section shows the xylem typically arranged like a V resembling that of a leaf trace bundle of the ferns and shows an adaxial folding of the spore bearing organ of *Marsilea*.

There are usually four sori present in the sporocarps (Pl. 3, fig. 14); but the occurrence of five (Pl. 3, fig. 13) or six is not uncommon. This number is probably the lowest recorded for any species of *Marsilea*, there being six present in *M. brachycarpa*. There is, therefore, a clear reduction seen in *M. aegyptiaca* in this respect. The entire mucilaginous mass with the placenta and the sori was removed from the sporocarp for observation and it was found that the distribution and development of both mega- and micro-sporangia in the sorus seems somewhat advanced. The truly gradate nature is somewhat disturbed. Not only this but the distribution and number of mega- and micro-sporangia in a sorus is indefinite. It was not possible to establish clearly the ratio between the number of micro-sporangia and mega-sporangia present in a sorus. It is interesting, therefore, to observe a reduction in the number of sori approaching *Pilularia* on the one hand and development of the sorus with irregular arrangement of the sporangia, an advanced feature, on the other.

The horizontal section (Pl. 3, figs. 13-15) shows clearly the right groove and the dorsal and ventral depressions; the left groove which is shallow is here occupied by the peduncle seen in transverse section. There are four or five sori, each sorus with micro- and mega-sporangia in advanced state of development (Pl. 3, fig. 16). The vascular



TEXT FIG. 5. Outlines of mega- and micro-spores of *Marsilea aegyptiaca* from Jodhpur. *a*, megasporangium (S = stalk, SP.W. = sporangial wall, S.W. = spore wall); *b*, single megaspore; c, microspores. x 40.

bundles constituting the net work of veins have been transversely cut towards the inner side of the wall of the sporocarp. The thick walls of the sporocarp formed by the prismatic cells have been prominently brought out in a photograph (Pl. 3, fig. 15) taken under polarised light. This section being the same as fig. 14 on the same plate taken under ordinary transmitted light. When the horizontal section passes through the wall of the sporocarp only, it reveals the behaviour of the main vascular bundle quite clearly as described above.

The vertical longitudinal section on the other hand will pass through either two or three sori of the sporocarp depending upon the number of sori present in the two halves of the sporocarp. Not only this, it passes generally either through the micro- or the mega-sporangia only. And the vertical transverse section will invariably pass through two sori and may show both the micro- and mega-sporangia in section. Mega- and micro-sporangia in advanced state of development are shown in fig. 16 on Pl. 3. The whole of the mega-sporangium is filled with a single thick-walled megaspore whereas the micro-sporangium is full of numerous microspores. The megaspores and microspores are drawn in text fig. 5.

## Systematics of Indian species

It may be mentioned at the outset that systematics of *Marsilea* is a neglected subject. Since the revision of the genus by R. Bräun (1870) and later by Baker (1887) or Bossier (1884) there has been no real attempt to classify the 60 or 70 species of *Marsilea* properly. The following ten species of *Marsilea* have been recorded from the sub-continent of India, but their authenticity needs a careful checking. Their distribution as far as known has been shown in the accompanying maps of India and Rajasthan.

| | |
|---|---|
| 1. *M. minuta* L. | India, etc. |
| 2. *M. quadrifolia* L. | N. India. |
| 3. *M. condensata* Bak. | Sind. |
| 4. *M. gracilenta* A. Br. | India. |
| 5. *M. brachycarpa* A. Br. | Pegu. |
| 6. *M. coromandelica* Burm. | India, etc. |
| 7. *M. brachypus* A. Br. | S. India. |
| 8. *M. poonensis Kolh.* | Bombay and Poona. |
| 9. *M. aegyptiaca* Willd. | Jodhpur and Ajmer. |
| 10. *M. ballardii* Gupta. | Ajmer. |

All these species except *Marsilea poonensis* and *M. ballardii* are mentioned in Christensen's 'Index Filicum' (1934). Baker in his revision, however, considers that in India there are only four well-defined species; of course, excluding *M. aegyptiaca* Willd. and *M. poonensis* Kolh. which have been reported after his revision. He considers *M. gracilenta* A. Br., *M. brachycarpa* A. Br. and *M. brachypus* A. Br., which were created by Bräun in 1870, as only varieties of *M. minuta* L. At the same time he created a new species known as *M. condensata* on the material collected by Dalzell from Sind (India). Sadebeck (1902), however, considers this new species of Baker as only a variety of *M. aegyptiaca* Willd.

It may be noticed that Baker in his revision did not recognise *M. quadrifolia* L. as a distinct Indian species; but in turn mentions *M. quadrifoliata* and this is regarded by Sadebeck (1902) as a variety of *M. minuta* L. So that the position of *M. quadrifolia* as a distinct species of India was thrown in doubt by the studies of these authors. Mr. F. Ballard who has so kindly identified some of the authors' collections recognises *M. quadrifolia* as a distinct Indian species.

It is evident from this brief indication that the systematic position of the ten Indian species mentioned in the beginning needs careful checking. Our investigation embodied in the present paper tells us that better methods of identifying and delimiting the species should be explored and the species well defined. As will be seen from our brief study of the Egyptian species from Jodhpur, the structure of the sporocarp seems to provide features of real diagnostic value. An attempt has been made in this paper to tabulate as clearly as possible the known structural features found in the sporocarps of most of the Indian species. These characters have been noted in the accompanying Table II.

On the whole it is seen that the ten Indian species look distinct from one another, although there is an overlapping of characters; for instance there may be some justification for Baker to consider *M. gracilenta* A. Br. and M. *brachypus* as varieties of *M. minuta* L. on the basis of his examination of the pedicels of the sporocarps and their attachment to the petiole. But other characters which are also of diagnostic value seem different in *M. gracilenta* and *M. brachypus*. At the same time Baker's determination of *M. brachycarpa* A. Br. as a variety of *M. minuta* L. can hardly be justified as is evident from the grouping of the sporocarps in the former generally in twos as against threes in the latter, their attachment of the sporocarps to the pedicels and also from the number of the sori in their sporocarps, there being only six in *M. brachycarpa* A. Br. and 10 to 12 in *M. minuta*.

Similarly, if we had the advantage of fuller data on the species *M. gracilenta* A. Br. and *M. brachypus*, perhaps it would be possible to argue that there was some justification for creating these two new species by Bräun. The known characters noted in the table above for the two species seem to prove almost conclusively the dissimilar nature of their sporocarps. The usefulness and systematic importance of the structural features in sporocarps for diagnosis is therefore clear.

Let us now examine Table II (pp. 436-7) to see if it is possible to distinguish one species from another or a group of species from another group on any single character or a set of characters of the sporocarp. It is seen that the relation of pedicel to petiole is an important and fairly well-defined single character noticeable in *Marsilea*, on the

TABLE

MORPHOLOGICAL FEATURES OF SPOROCARPS

| S. No. | Species | Disposition of Sporocarps | Relation of Pedicel to Petiole | Relation of Pedicel to Pedicel | Shape and Size (in length) |
|---|---|---|---|---|---|
| 1. | *M. minuta* L. | Generally 3, sometimes 2; rarely solitary | At the base | Slightly connate or free | Bean-shaped, compressed, ribbed and bordered 1/10″ |
| 2. | *M. quadrifolia* L. | 2 to 3, rarely solitary | Adnate | Connate for about half their length | Oval, sub-compressed rarely margined, not ribbed 1/15″ to 1/3″ |
| 3. | *M. condensata* Bak. | In tufts, may be solitary | At the base | ... | Sub-orbicular 1/8″ |
| 4. | *M. gracilenta* A. Br. | ... | At the base | Slightly connate or free | Not ribbed. More or less rectangular compressed |
| 5. | *M. brachycarpa* A. Br. | Generally 2 | Adnate | Connate | Circular, wrinkled or ribbed. 1/16″ |
| 6. | *M. coromandelica* Burm. | Solitary | At the base | ... | Bean-shaped oval. ¼″ |
| 7. | *M. brachypus* A. Br. | 2 to 3 | At the base | Slightly connate or free | Rounded but not bordered, distinctly ribbed. 3/16″ |
| 8. | *M. poonensis* Kolh. | Generally 2 sometimes 3 developed acropetally | At the base | Slightly connate | Pod-like oval, simulating bi-convex lens. 1/8″-1/5″ ribbed |
| 9. | *M. aegyptiaca* Willd. | Solitary | At the base | ... | Squarish 1/12″-1/10″ |
| 10. | *M. ballardii* Gupta | One, two three or more | At the base | Free or connate | Squarish ⅕″. |

II

IN THE INDIAN SPECIES OF *MARSILEA* L.

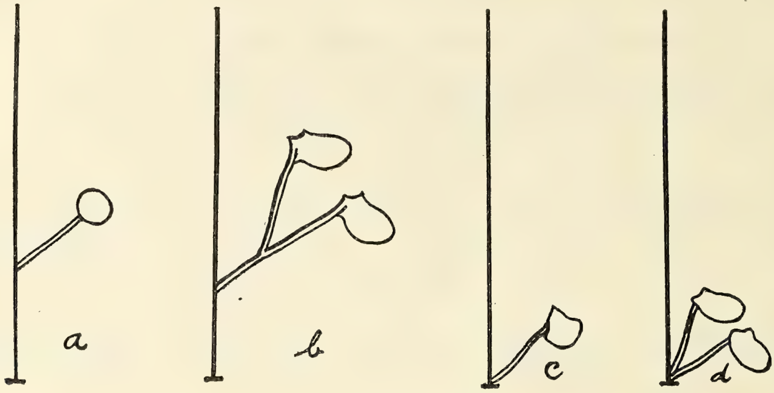
| Size ratio : Pedicel : Sporocarp | Wall-surface | Attachment of Pedicel to Sporocarp | Number and Nature of Horns | Soral Number | Remarks |
|---|---|---|---|---|---|
| 2 : 1 or 3 : 2 | Strigose or glabrous | Partially adnate | 2, upper longer | 10–12 | Prominent dorsa suture is present on the sporocarp. |
| 2 : 1 or 1 : 1 | Strigose | Partially adnate | 2, almost similar | 16–20 | Pedicels decurved and ascending. |
| 2 : 1 | Densely silky haired | Fully adnate? | Very obscure upper one | *ca*. 10 | Pedicels stiffly erect. |
| 1 : 1 or 2 : 3 | Hairs erect | Fully adnate | 2, upper blunt, lower obscure | ... | Pedicels erect. |
| 2 : 1 | Hairy | Fully adnate | 2, similar blunt | 6 | Pedicels horizontal. |
| 6 : 1 or 2.5 : 1 | Strigose (?) | Partially adnate | 2, almost similar and prominent | ...... | Pedicels somewhat descending. |
| 2/3 : 1 | Long erect hairs | Fully adnate | 2, upper prominent | 7 ? | Pedicels horizontal or steeply bent downwards from the stalk. |
| 2 : 3 or 1 : 1 | Strigose | Fully adnate | Only upper and prominent | 10–14 | Pedicels reflexed. |
| 3.3 : 1 | Silky haired | Fully adnate | Bluntly pointed upper one | 4–6 | Pedicels erect ; sporocarps prominently grooved. |
| 2 : 1 | Strigose | Fully adnate | Upper one pointed | 6–8 | Pedicels erect ; without grooves or depressions. |

## TABLE II

### MORPHOLOGICAL FEATURES OF SPOROCARPS IN THE INDIAN SPECIES OF *MARSILEA* L.

| S. No. | Species | Disposition of Sporocarps | Relation of Pedicel to Petiole | Relation of Pedicel to Pedicel | Shape and Size (in length) | Size ratio: Pedicel: Sporocarp | Wall-surface | Attachment of Pedicel to Sporocarp | Number and Nature of Horns | Soral Number | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | *M. minuta* L. | Generally 3, sometimes 2; rarely solitary | At the base | Slightly connate or free | Bean-shaped, compressed, ribbed and bordered 1/10" | 2 : 1 or 3 : 2 | Strigose or glabrous | Partially adnate | 2, upper longer | 10-12 | Prominent dorsa suture is present on the sporocarp. |
| 2. | *M. quadrifolia* L. | 2 to 3, rarely solitary | Adnate | Connate for about half their length | Oval, sub-compressed rarely margined, not ribbed 1/15" to 1/3" | 2 : 1 or 1 : 1 | Strigose | Partially adnate | 2, almost similar | 16-20 | Pedicels decurved and ascending. |
| 3. | *M. condensata* Bak. | In tufts, may be solitary | At the base | ... | Sub-orbicular 1/8" | 2 : 1 | Densely silky haired | Fully adnate? | Very obscure upper one | *ca.* 10 | Pedicels stiffly erect. |
| 4. | *M. gracilenta* A. Br. | ... | At the base | Slightly connate or free | Not ribbed. More or less rectangular compressed | 1 : 1 or 2 : 3 | Hairs erect | Fully adnate | 2, upper blunt, lower obscure | ... | Pedicels erect. |
| 5. | *M. brachycarpa* A. Br. | Generally 2 | Adnate | Connate | Circular, wrinkled or ribbed. 1/16" | 2 : 1 | Hairy | Fully adnate | 2, similar blunt | 6 | Pedicels horizontal. |
| 6. | *M. coromandelica* Burm. | Solitary | At the base | ... | Bean-shaped oval. ¼" | 6 : 1 or 2.5 : 1 | Strigose (?) | Partially adnate | 2, almost similar and prominent | ... | Pedicels somewhat descending. |
| 7. | *M. brachypus* A. Br. | 2 to 3 | At the base | Slightly connate or free | Rounded but not bordered, distinctly ribbed. 3/16" | 2/3 : 1 | Long erect hairs | Fully adnate | 2, upper prominent | 7 ? | Pedicels horizontal or steeply bent downwards from the stalk. |
| 8. | *M. poonensis* Kolh. | Generally 2 sometimes 3 developed acropetally | At the base | Slightly connate | Pod-like oval, simulating bi-convex lens. 1/8"-1/5" ribbed | 2 : 3 or 1 : 1 | Strigose | Fully adnate | Only upper and prominent | 10-14 | Pedicels reflexed. |
| 9. | *M. aegyptiaca* Willd. | Solitary | At the base | ... | Squarish 1/12"-1/10" | 3,3 : 1 | Silky haired | Fully adnate | Bluntly pointed upper one | 4-6 | Pedicels erect; sporocarps prominently grooved. |
| 10. | *M. ballardii* Gupta | One, two three or more | At the base | Free or connate | Squarish ⅛". | 2 : 1 | Strigose | Fully adnate | Upper one pointed | 6-8 | Pedicels erect; without grooves or depressions. |

basis of which these ten Indian species can be segregated as follows (text fig. 6).



TEXT FIG. 6. Diagrammatic representation of the attachment of the pedicel to petiole in the genus *Marsilea* with special reference to Indian species.

Relation of Pedicel to Petiole

Pedicel adnate
*M. quadrifolia* L.

Pedicel basal
All other species

Sporocarps more than one connate or free.
1. *M. minuta* L.
2. *M. brachypus* A. Br.
3. *M. brachycarpa* A. Br.
4. *M. gracilenta* A. Br.
5. *M. poonensis* Kolh.
6. *M. ballardii* Gupta.

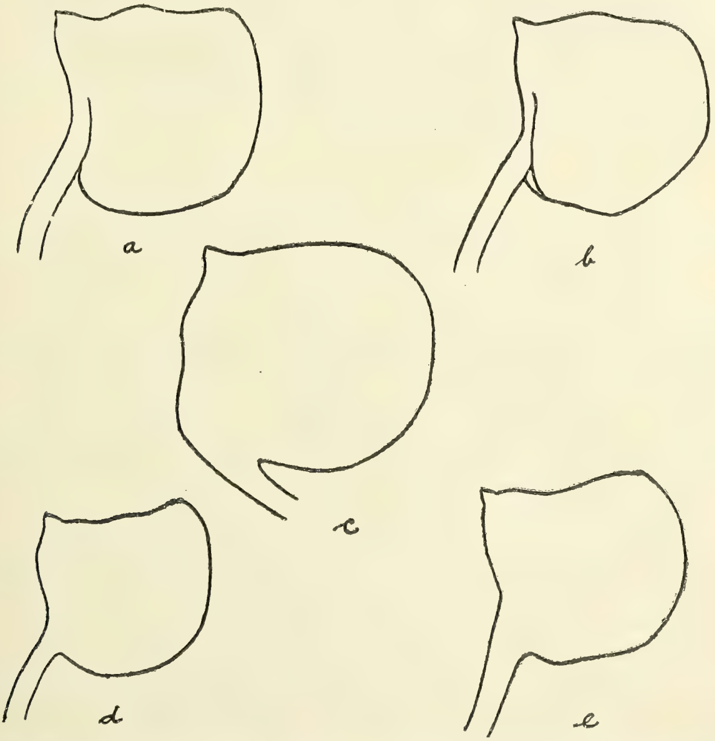
Sporocarps solitary.
1. *M. aegyptiaca* Willd.
2. *M. coromandelica* Burm.
3. *M. condensata* Bak.

This idea is also in conformity with Baker. He has also given great importance to this character in defining various groups of *Marsilea;* but he has not taken into consideration other features of the sporocarps in delimiting the various species of *Marsilea*. For instance he considers *M. brachypus, M. brachycarpa* and *M. gracilenta* as only varieties of *M. minuta;* probably noticing only the characters of the pedicels. If this character alone is considered as of diagnostic value, *M. poonensis* will have to be described as a variety of *M. minuta*. But it should not be so unless other characters also point in the same direction. Even a single character like the number of sori in the sporocarps may be an important argument against Baker's method of delimiting the species.

Our information on *Marsilea gracilenta* is poor, yet unribbed nature of the sporocarps, smaller size of the pedicels as compared to the size of the sporocarps and erect hairs on the sporocarps provide features distinct enough for separating it from *M. minuta*. Sadebeck too thinks of *M. gracilenta* as a distinct species.

The systematic position of *M. brachycarpa* and *M.brachypus* with reference to *M. minuta* or their relationship between themselves must also be considered doubtful for the present. This is due to the deficiency of material and information available to us on the subject, although it seems that *Marsilea brachypus* is more related to *M. minuta* than *M. brachycarpa*. In fact, we find that *M. poonensis* resembles much more closely *M. minuta* than either of the species created by Bräun and described above, or any other Indian species. The only difference that appears as of distinguishing nature between these two latter species is the size of the pedicel and the nature of the horn. Further, Mr. Ballard of the Kew Herbarium had identified this material of *Marsilea* from Poona as a new species in 1938. Although a clear diagnosis of the species has not yet been published in spite of its detailed description (1937), we feel that on further examination it may turn out to be only a variety of *M. minuta*.

The other group of Indian Marsileas with solitary sporocarps seems well defined. Baker's identification of Dalzell's *Marsilea* from Sind



TEXT FIG. 7. Outlines of sporocarps of *M. aegyptiaca* (*a* & *b* Prescott coll. from Astrakhan; *d* Figari coll. from upper Egypt; *e* Gupta coll. from Jodhpur.) and *M. condensata* (*c* Dalzell coll. from Sind.) for comparison, kindly drawn by Mr. F. Ballard from herbarium sheets at Kew, London.

as a new species, *M. condensata*, seems justified and Sadebeck's idea of considering the same as only a variety of *M. aegyptiaca* (1902) does not seem to hold good for it is clear that sporocarp in *M. condensata* is much larger in size and differs in shape from *M. aegyptiaca* (text fig. 7 drawn by Mr. Ballard). Besides, the sporocarp in *M. condensata* is densely covered with silky hairs, possesses a less prominent horn, and contains 10 sori instead of only four, five or six of *M. aegyptiaca*. *M. coromandelica* too seems quite distinct from the other two species in this group, for it possesses a much larger pedicel as compared with the size of its sporocarp; in fact, the pedicel and sporocarp ratio in this species is quite different from the rest of the Indian species. Besides, this species is characterised by different type of leaves namely in having pellucid streaks in the areolae of the leaves (Baker 1887). Our knowledge, however, of this species is also deficient in many respects.

Thus, it appears that the ten Indian species may be regarded as distinct from each other for the present, and final opinion deferred till further data are collected on the structure of the sporocarps by examination of the original material. It may, however, be useful to investigate some other details in the vegetative structures of these doubtful species; for instance, the orientation of the stomata, the distribution of the stomata, and the size of the stomata, in the leaves; detailed information on the size and shape of hairs on different organs of the plant and even minute examination of the internal anatomy of their vegetative organs; so that these may provide subsidiary data for definite determination of the identity of these species.

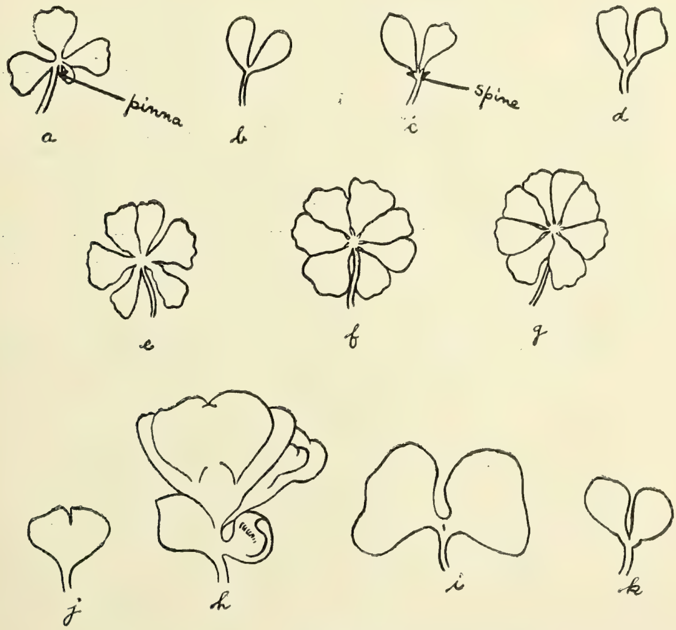
## DISCUSSION

The morphology of the leaf as well as the sporocarp in *Marsilea* has been a matter of discussion among botanists. The present leaf is no doubt a reduced structure, perhaps from the once pinnate leaf, and so also the sporocarp modified from some part of that leaf.

Again the petiole of the leaf and the peduncle of the sporocarp may or may not be homologous but structurally they are organised on a similar plan: one ends into the so called leaflets and the other in the sporocarp. Whether the latter represents the former organs and is comparable to the whole leaf or only the distal portion and represents only some parts of the leaf cannot be easily settled. Our work on the morphology of *M. aegyptiaca* is yet incomplete but from what we have noticed, it seems difficult to reconcile, for instance, with the statement: 'If the sori are marginal in this sense they should have obtained their vascular supply from the intersoral bundles rather than from the commissurals, (Puri and Garg 1953).

*Marsilea aegyptiaca* produces a solitary sporocarp. Its position with reference to the petiole is definitely lateral, its vascular supply arises in the manner of a pinna trace and resembles the anatomy of the petiole. There is, therefore, no doubt about its foliar nature. From what part of the leaf it gets modified is a matter that has been a long debated question. Bräun and Goebel considered this as modified from a single leaflet but the sporocarps formed artificially by Büsgen from single leaflets were always abnormal. Chrysler thought that the sporocarp represents two fused lateral basal pinnae. Some others have compared the structure in *Marsilea* with *Botrychium* and *Ophioglossum.* The double vascular supply in the latter as compared with a single trace in *Marsilea*, however, should rule out this possibility.

Johnson on the other hand based his conclusions on developmental studies and showed that the peduncle and sporocarp are equivalent to the petiole and the capsule of *Marsilea* is only a swollen end of the petiole in which the marginal cells instead of forming the leaflets produce the sporangia. Büsgen holds quite contrasting views and says that the peduncle is similar to the petiole only and leaflets modify themselves into the sporocarp. This is supported by similar anatomical structures of both the petiole and the peduncle and similar venation of the leaflets and the sporocarp, there being only a difference in degree. There are two strong vascular bundles in the sporocarp whereas four in the leaflets. The sporocarp may really represent only two leaflets, the other two having been lost and may be represented by the two horns. The observations of Mahabale and Gorgi (1948) in the production of horns in place of proximal leaflets in *M. quadrifolia* seem to support this conclusion. Further in *M. quadrifolia* and *M. aegyptiaca* sometimes only two leaflets are produced (text fig. 8) in the adult plant as an abnormal feature, resembling the normal state of affairs in the allied genus *Regnellidium diphyllum.* The structure of the sporocarps in the two cases is also essentially similar.



TEXT FIG. 8. Abnormal leaves of *Marsilea. M. quadrifolia* (a-g) after Mahabale and Gorgi; *M. hirsuta* (h) after Büsgen; *M. aegyptiaca* (j & k) and a normal leaf of *Regnellidium diphyllum* (i) for comparison (Diagrammatic).

The vascular supply of *Pilularia* sporocarp is also somewhat similar to a four-parted leaf of *Marsilea*. Not only this, the reduction in the number of sori as seen in *M. aegyptiaca* is such as to approach *Pilularia*. The latter certainly represents a more reduced type among the Marsileaceae with its bladeless petiole, recalling the earliest juvenile condition of the leaf in *Marsilea* (Pl. 1, fig. 2). *Marsilea aegyptiaca* producing two leaflets, though as an abnormal feature, in absence of the lower horn without any trace of its vascular supply (absence of vascular hump) and finally showing reduction in the number of sori, becomes the most reduced species in the genus *Marsilea* and comes closer to both *Regnellidium* and *Pilularia*.

The sporocarp of *Marsilea* is probably modified from the two distal leaflets, the proximal ones being represented by the horns. There is not much doubt that the original leaf of *Marsilea* must have been a pinnate structure of some type.

## SUMMARY

A brief account of the occurrence of *Marsilea aegyptiaca* Willd. in Rajasthan was published by the senior author only in last April (Gupta, 1955). It shows the usual ecological variations in its vegetative parts that are found in the genus *Marsilea* and during dry seasons the sub-terrestrial plants produce sporocarps very profusely, giving the plants a tufted appearance. The sporocarps are borne singly and distinctly at the nodes and at the base of the petioles. The shape of the sporocarp is very characteristic It is squarish in outline, variously grooved and possessing a single upper horn which is somewhat blunt. It usually contains only four sori but sometimes five or six are also present. This number is the smallest among the species of *Marsilea* and is approached only in *M. brachycarpa* among the Indian types. In general morphology and anatomy of the vegetative parts, the plant appears more or less similar to other species, Indian or foreign; but the structure of the sporocarp shows some interesting features in its organization.

An attempt has been made to review, if not exactly revise, the systematic position of the Indian species on the basis of the characters of the sporocarp and it has been shown how our common species can now be easily identified. The morphological nature of the vegetative parts as well as the sporocarp, a subject of theoretical importance, has also been dealt with briefly in the concluding part of the paper.

## ACKNOWLEDGMENTS

We are greatly indebted to Sir E. J. Salisbury and Mr. F. Ballard, the Director and the Peteridologist respectively of the Royal Botanic Gardens, Kew, for identification of the Indian species and clarifying various points of systematic nature that arose during the course of the work. To them we are also grateful for some material of *Marsilea aegyptiaca* Willd. from their original collections at Kew and for the camera lucida drawings of the sporocarps of *M. aegyptiaca* and *M. condensata*. Our thanks are due to Prof. A. H. Montasir, Ibrahim University of Cairo, for some Egyptian material of *Marsilea* *aegyptiaca*. We express our gratefulness to Dr. K. P. Biswas and Mr. R. S. Rao formerly of the Calcutta Herbarium for help as well as for the facilities provided us to work in the herbarium during the Christmas holidays. To Prof. G. G. Kolhatkar of Fergusson College, Poona, we are indebted for the material of *M. poonensis*; to Dr. T. S. Mahabale of Poona University, Dr. P. N. Mehra of the Panjab University, Dr. A. R. Rao of the Lucknow University and Prof. P. Maheshwari of the Delhi University our respectful thanks are due for advice and references. For the entire work of photography in connection with this investigation, we are extremely obliged to Dr. S. Venkatachary and Prof. K. P. Rode who provided us with full facilities in their respective laboratories at Maharana College, Udaipur. Prof. B. Tyagi of Government College, Ajmer, gave us all help in collecting *M. aegyptiaca* locally and its study in his laboratory. We are indebted to Mr. A. H. G. Alston of the British Museum, London, for photographs of the type specimens of some Indian species preserved in Berlin.

It is our pleasure to record the assistance given us by the ministerial staff of the Botany Department, Jaswant College, Jodhpur during the preparation of the manuscript.

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## EXPLANATION OF PLATES 1-3

### Plate 1, figs. 1-6.

FIG. 1. *Marsilea aegyptiaca* Willd. A single specimen showing tufted nature. *ca.* natural size.

FIG. 2. Same. Showing the development of leaves from juvenile to the adult form, slightly reduced.

FIG. 3-5. Same. Single sporocarp in three different views: 3, showing fully adnate stalk and ventral depression; 4, dorsal depression and upper blunt horn; 5, right groove and adpressed hairs. x 9.

FIG. 6. Same. Multicellular hairs with their pointed end cells and mosaic pattern of the wall of the sporocarp. x 70.

### Plate 2, figs. 7-12.

FIG. 7. *Marsilea aegyptiaca* Willd. T. S. of the sub-terrestrial leaf showing organisation of its tissues and stomata on both sides. x 200.

FIG. 8. Same. Upper epidermis with stomata and sinuous epidermal cells of a sub-terrestrial plant. x 200.

FIG. 9. Same. T. S. of the rhizome showing a typical amphiphloic siphonostele with sclerotic pith characteristic of a sub-terrestrial plant. x 65.

FIG. 10. Same. T. S. of a root showing a diarch stele with thick walled broad inner cortex. x 75.

FIG. 11. Same. T. S. of a petiole showing characteristic features. x 40.

FIG. 12. Same. T. S. of the stalk of the sporocarp showing a broad thick walled inner cortex. x 100.

### Plate 3, figs. 13-17.

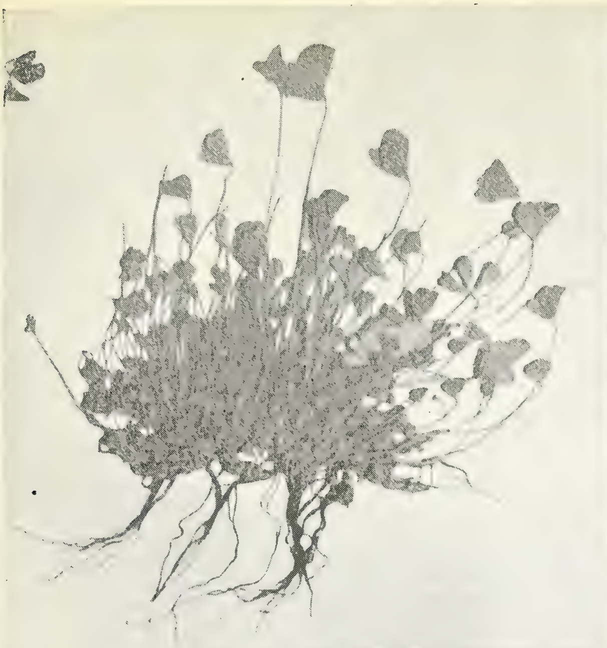
FIG. 13. *Marsilea aegyptiaca* Willd. Horizontal section of the sporocarp showing five sori. x 20.

FIG. 14. Same. Showing the usual four sori, transversely cut V.B. of the wall as well as the vascular supply to the sorus. Note its characteristic outline showing its grooves and depressions. x 20.

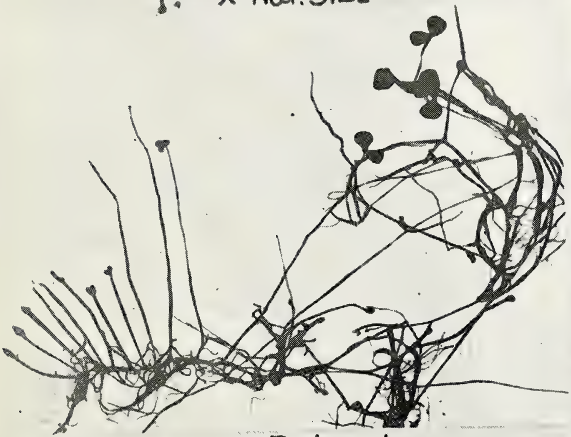
FIG. 15. Same. Under polarized light. x 20.

FIG. 16. Same. Showing well developed mega- and micro-sporangia. x 100.

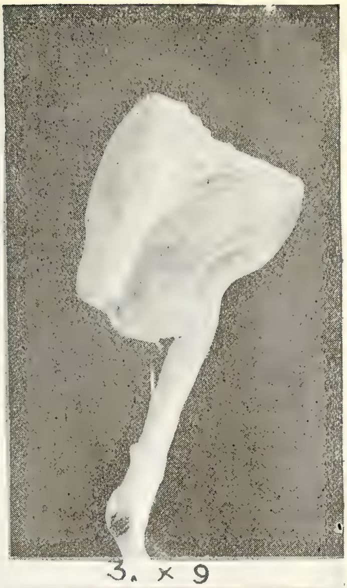
FIG. 17. Same. Photograph of one of the specimens collected by J. Schweinfurth from Tel-el-kabir, Lower Egypt in 1880 from Kew (London). x 2.



1. × Nat. SIZE



2. × Reduced.



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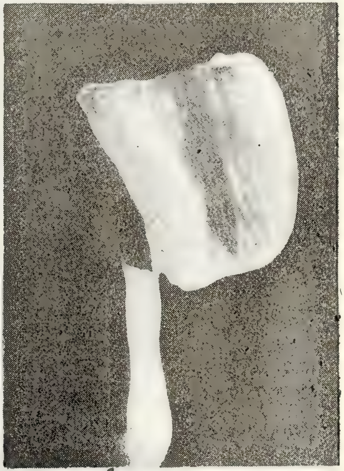

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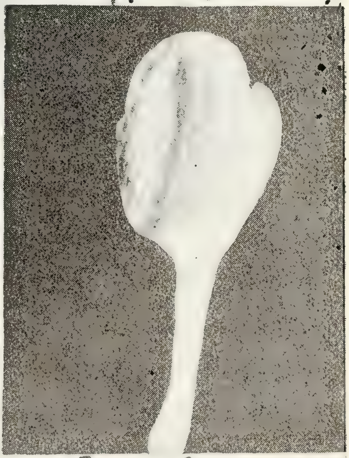

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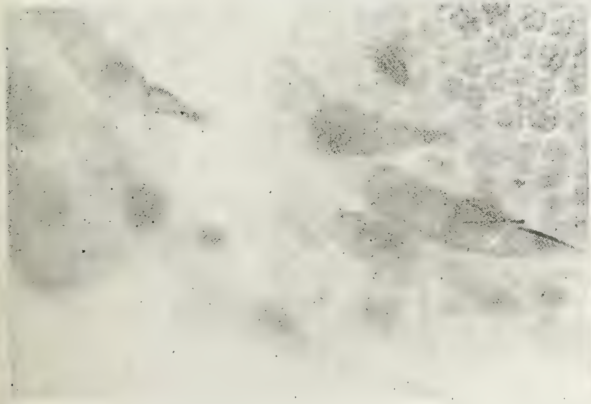
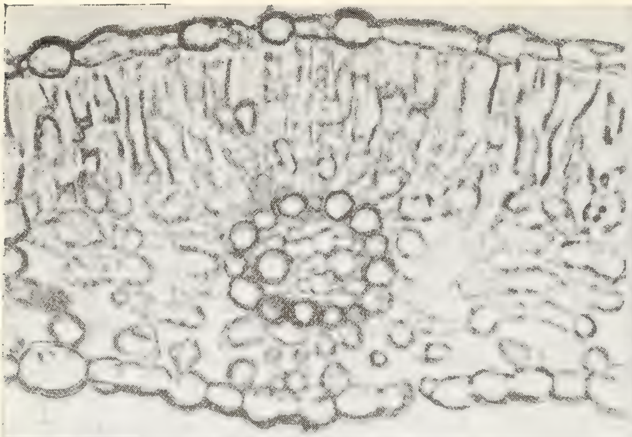


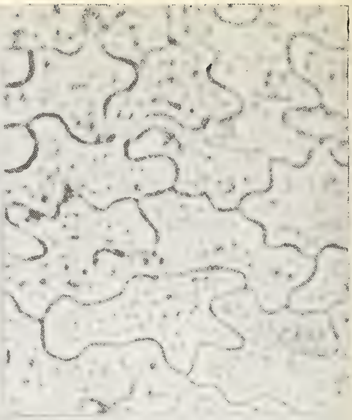
6. × 70

Figures 1-6.

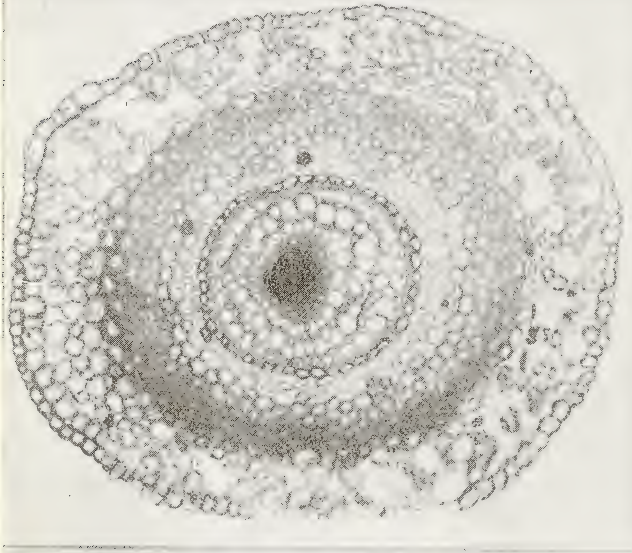
*(For explanation see end of article)*



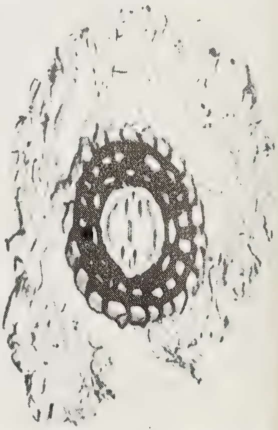
7. × 200



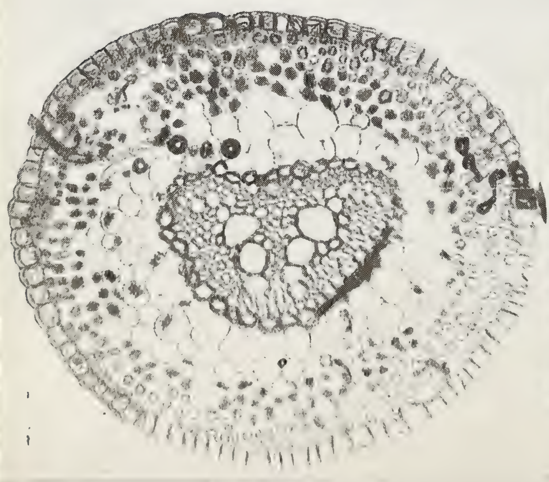
8. × 200



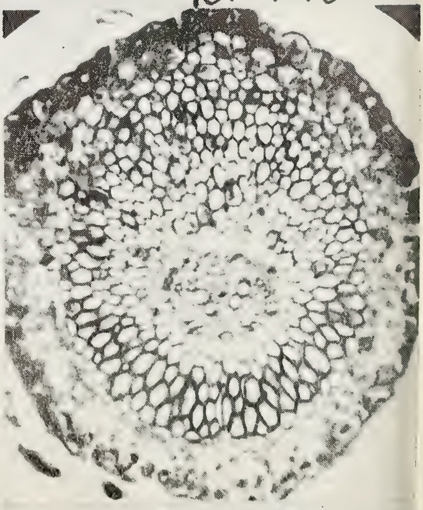
9. × 65



10. × 75

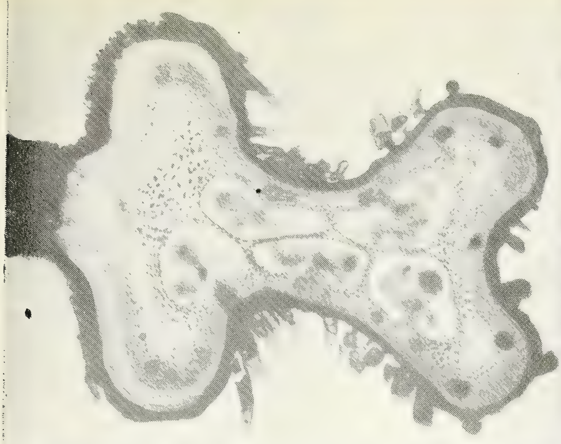


11. × 40

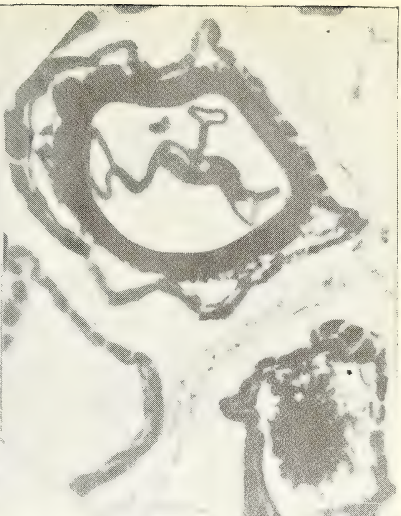


12. × 100

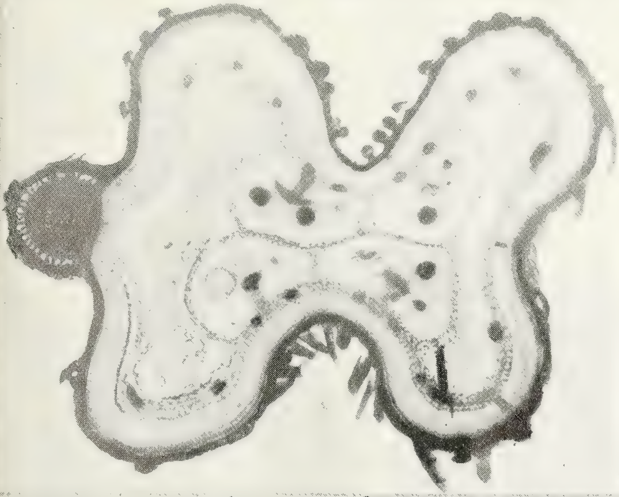
Figures 7-12.
*(For explanation see end of article)*



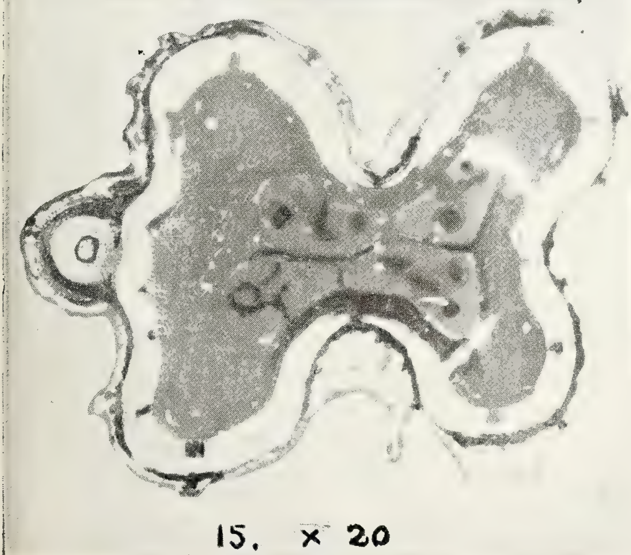
13 × 20



16. × 100



14. × 20



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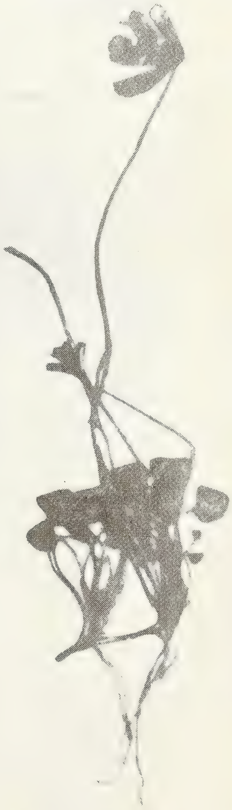

17. × 2

Figures 13-17.
*(For explanation see end of article)*

# IN MEMORIAM

## SUNDER LAL HORA

(*With a plate*)

To most of us associated with the activities of the various scientific organizations of the country, and latterly of the Indian Board for Wild Life, the news of the death of Dr. Sunder Lal Hora, which occurred on 8th December 1955, has come as a grievous shock, and to the many who knew him more intimately as the realization of the loss of a dear friend.

This loss is all the more poignant when one's personal bond with him dating back to over three decades is irrevocably snapped by the cruel hand of death. There appears a tragic touch in it when I recall the circumstances of our meeting in my house in May last under the shadow of a bereavement afflicting me. Dr. Hora immediately on his return from Madras, where he had gone to attend the All-India Zoo Superintendents' Conference, hurried to bring to me, with his overflowing kindliness, solace and comfort in my sorrow due to the loss of my son who happened to be a distinguished pupil of his and associated with him in his researches. Alas, what an irony of fate that before a half-year had ended he himself was to be no more!

My earliest contact with Hora was in 1923, when at the request of Col. R. B. Seymour Sewell, the then Director, I undertook the work of rearrangement and overhauling of the bird collection of the Zoological Survey of India. For quite a number of years thereafter I was a regular visitor to the Indian Museum, and after the day's work when I had to pass by his room a broad smile from Hora would welcome me in and we seldom failed to beguile ourselves in each other's company for a while. We had a common meeting ground in the hall of the Asiatic Society as well, and my countryhouse with its extensive fish tank and aviary was always a centre of great attraction for him, which he made into a relaxing holiday resort.

Hora, who began his research career in 1917 at the age of 22, was recruited to the Zoological Survey of India as a research scholar in 1919 and appointed an Assistant Superintendent in 1921. While still a student at the Government College, Lahore, he discovered the presence of Haversian Canals in the limb bones of *Rana* and discussed the homologies of Weberian Ossicles of *Labeo rohita*. His work on the fish and fisheries of India earned him the D.Sc. of the Punjab University in 1922, and in 1928 his studies on the ecology, bionomics and evolution of torrential fauna with special reference to the organs of attachment secured him the D.Sc. of the Edinburgh University. For a period of five years (1942-47) he was Director of Fisheries of undivided Bengal, coming back then to the Zoological Survey of India as its Director, which post he held till his death.

A believer in hard work, his output of scientific literature was prodigious; he published some 400 papers on various subjects in many foreign and Indian journals, including the pages of the *Journal of the*

*Bombay Natural History Society.* To celebrate the Silver Jubilee of his first scientific contribution his numerous past students, colleagues and admirers produced in 1951 a complete bibliography of his publications up to 1950[1]. The titles of his papers indicate the vast and varied field of his activities, and the volume is a fitting monument to his eminence and zeal as a scientific worker. He was, however, best known as an ichthyologist, though his contributions in other fields are also of great importance. Primarily a systematist interested in freshwater fishes of the Oriental Region, he held a broad vision of this branch of zoology and his papers are full of interesting observations on the ecology and bionomics of the fishes he studied.His taxonomic work, especially on the hill-stream fishes, led him to probe into the problem of the changing river systems of India due to Himalayan tectonic movements and to enunciate what is now well known as 'Hora's Satpura Hypothesis', which attempts to explain the presence of Malayan elements in the fauna of Peninsular India.

On the applied side, his studies on the pond culture of fishes for increasing food production have aroused world-wide interest, and in 1949, at Lake Success, he was invited by the United Nations Organisation to open a discussion on 'Pond culture of warm water fishes'. He was interested in the conservation of fishes of economic importance, especially the migratory species, and made notable contributions to our knowledge of the biology of the Indian Shad, *Hilsa*, which was subsequently taken up as an international problem for intensive investigations. In 1952 he was the chairman of the *Hilsa* Sub-Committee of the Indo-Pacific Fisheries Council.

Dr. Hora had always been interested in the scientific knowledge possessed by ancient Hindus, especially in the field of fish and fisheries, as revealed in Sanskrit literature and archaeological pieces such as the edicts of Asoka and potteries of Mohenjo-Daro and Harappa. Those who have heard him speak either in the Indian Museum or in the Asiatic Society, Bengal, will recall the great interest he aroused in his audiences.

Essentially a student of Nature he was deeply interested in the preservation of wild life and in the establishment of National Parks in India. He was the first Hony. Secretary-General of the Indian Board for Wild Life.

Dr. Hora took a lively interest in the welfare of the Bombay Natural History Society. He was an active member of the Society's Advisory Committee since 1945 and his valuable advice and suggestions were always eagerly sought and freely given.

Among the many academic distinctions conferred on him by foreign and Indian scientific institutions, he was the recipient of the Asiatic Society's 'Joy Gobind Law Memorial Medal' (1944), the National Geographical Society of India's 'Jawaharlal Nehru Medal' (1951) and the Zoological Society of India's 'Sir Dorab Tata Memorial Medal' (1951).

By his sudden death we sadly miss a personality of noble character, and charming courtesy endowed with great qualities of heart and mind, an eager willingness to help, and a wide knowledge generously placed

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[1] A limited number of copies of the Bibliography is still available at the Bombay Natural History Society.

Dr. Sunder Lal Hora

at the disposal of all. For all those who, throughout the world, have had contact with him and shared in any of his manifold interests, the name of Sunder Lal Hora will remain as a symbol of what I should like to term 'biological humanism' in the most noble sense of the word.

S. C. LAW

## Lt.-Col. K. G. GHARPUREY, i.m.s. (Retd.)

We regret to announce the death of Lt.-Col. K. G. Gharpurey at Poona on March 6, 1956, at the age of 76. Col. Gharpurey was born on July 28, 1880. He was educated at Nagpur and Calcutta, and the Medical College at Lahore, and also attended the School of Medicine, Edinburgh, and University College, London.

He entered the Indian Medical Service in 1906 and was posted as Civil Surgeon in Somaliland between 1909 and 1914. In the First World War (1914-1919) he did military duty in Africa and the Persian Gulf, and thereafter served as Civil Surgeon in various districts of the then Bombay Presidency, retiring as Surgeon-General in 1935.

Col. Gharpurey joined the Bombay Natural History Society in 1910, since when his connection with it was intimate and fruitful. He was particularly interested and specialized in the study of snakes, and the Society constantly benefited from the valuable specimens he collected and presented to it from the various districts where his duties took him. He was a frequent contributor on snakes to the pages of the *Journal*, the more important of his papers being:

Snakes of Sholapur: vol. 32, p. 224 (1927).
Snakes collected at Belgaum: vol. 34, p. 585 (1930).
Snakes of Nasik: vol. 34, p. 1,085 (1931).
Snakes collected in Ahmednagar: vol. 36, p. 272 (1932).
Snakes collected in Belgaum : vol. 37, p. 942 (1935).
Further list of snakes of Ahmednagar: vol. 38, p. 198 (1935).

In addition to these there are several useful notes by him from time to time on individual variation in different species, habits, and other aspects of snake study.

Col. Gharpurey's interest in the Society did not end here. When the new Natural History Wing of the Prince of Wales Museum Bombay, was being planned he made a special donation of Rs. 5,000 to the Society to be utilized for the exhibition gallery of reptiles. The beautiful habitat group of the Malayan Python and many of the smaller snake groups, as also the superb anatomical scale-models for students in the Museum's Reptile Gallery, are abiding memorials to the deep interest he cherished in the subject and to his public-spirited generosity. The Society honoured him, and itself, by electing him a Vice-Patron in 1935.

Besides his papers published in the *Journal*, Col. Gharpurey has to his literary credit 'The Snakes of India' (in English) now in its 4th edition, and the only book of its kind currently available. He also wrote two books in Mahratti, on 'Snakes of Maharashtra' and 'Animals and Health', which are of recognized merit and usefulness.

S.A.

# REVIEWS

1. THE WORLD OF SMALL ANIMALS. By T. H. Savory. Pp. 160 ($8\frac{3}{4}'' \times 5\frac{3}{4}''$), 16 plates, 30 text-figures. London, 1955. University of London Press Ltd. 15*s*. net.

The author's wide experience as a teacher makes available his intimate knowledge of Nature to students and amateur naturalists in this very helpful guide. Though written mainly with the view of helping beginners in Britain, it will be equally useful to students in other parts of the World to learn the basic principles underlying the study of any group of animals. The emphasis is on the study of small animals, especially the obscure groups whose members, though quite common, are still scarcely known either due to their apparent dullness or economic unimportance.

The book is divided into two sections. In the first ten chapters the methods of study are explained. A chapter each is devoted to various aspects of study such as Collection, Preservation, Examination, etc. Technical points are dealt with in simple and easily understandable terms. The difficulties confronting the beginner are fully explained. The author lays stress on the value of field observation, and would have his readers strive for a correct appreciation of the value of being a naturalist as well as laboratory worker.

In the final thirteen chapters a selected number of common animals are described in the light of the methods explained in the earlier chapters. The value of these descriptions is much enhanced by the beautiful photographic plates.

J.C.D.

2. THE NATURAL HISTORY OF MAMMALS. By François Bourliére. Translated from the French by H. M. Parshley. Pp. xxi + 363 + xi ($8\frac{1}{4}'' \times 5\frac{3}{4}''$), 24 plates, 97 text-figures. London, 1955. George G. Harrap & Co. Ltd. 21*s*. net.

3. MAMMALS OF THE WORLD: Their Life & Habits. By François Bourliére. Pp. 223 ($11\frac{1}{8}'' \times 8\frac{1}{2}''$). With 16 coloured and 216 black-and-white photographs, and numerous text-figures. London, 1955. George G. Harrap & Co. Ltd. 60*s*. net.

Compared with the endless stream of bird books of every description—from inexpensive regional brochures to sumptuous, lavishly illustrated tomes—that pours out from the publishers of Europe and America, the wavering trickle of literature dealing with mammals is truly surprising. And this despite the fact that mammals, owing to the bizarre forms and spectacular proportions of some of them, are far more popular with the normal run of visitors to zoos and circuses.

Scientific or quasi-scientific interest in wild mammals is less widespread than in birds chiefly because most of them are of nocturnal habits and difficult to observe. The smaller ones conceal themselves during the day in holes and burrows, and the larger ones in remote forest recesses, or otherwise away from the normal haunts of man, unlike birds which permit themselves to be heard and watched, and enjoyed and studied without any such difficulty. The important contributions made to ornithological science by intelligent bird watchers are not possible to the same extent with wild mammals, because of their innate shyness and predominantly nocturnal way of life. That the study of mammals is so much less popular with amateur naturalists than bird-watching, is thus easy to understand. Their field study involves far greater ingenuity, patience and perseverance; and the collecting of vital data is a slow, often laborious, and sometimes disappointing process. However, if any one doubts that the forms of mammals and the study of their ways and habits can be just as enthralling and rewarding to a student of natural history, Prof. Bourliére's books will bring him corrective conviction. The first volume, as its name signifies, is a comprehensive account of all that concerns the living mammal. For though less numerous than the devotees of birds, there are nevertheless a great many ardent students of mammals working on different aspects of their morphology, physiology, psychology and ecology, in both laboratory and field, and in many different corners of the globe. The results of their studies are being published in many technical as well as popular scientific journals, in many different languages. Such papers are often widely scattered and usually not known to, or readily available—or perhaps even intelligible, to the non-specialist. Therefore Prof. Bourliére has done an immense service to biology in marshalling and synthesizing so skilfully all the more important data in this pleasantly assimilable form. The author is primarily an ecologist, and it is refreshing to find the emphasis throughout the book on the ecological aspect of wild mammals—their habits, their relations with, and their adaptations to, their natural environment.

The book is a masterly survey of the present state of our knowledge of the bionomics of wild mammals. It covers the following topics: Locomotion; Food and Feeding Habits; Home, Territory, and Home Range; Defence and Protection; Sexual Life and Reproduction; Development and Longevity; Migrations; Social Life; Environment; Structure and Dynamics of Natural Populations. The section listing the General and Special Bibliographies at the end of the book gives some idea of the vastness of the material drawn upon, yet it is the harmony of the synthesis that makes the book such a pleasure to read; and its usefulness and attractiveness are enriched by the carefully chosen photographs, and by M. Paul Barruel's beautiful line drawings in the text.

All in all, it is a most welcome addition to mammalian literature, and should go a long way towards popularizing interest in a group of animals that is closest to us, not only in the matter of structure and genealogy, but also by their vital impact upon almost every aspect of human activity and endeavour.

The art of wild life photography is a comparatively recent innovation, made possible largely by the advances in modern photographic apparatus of precision. Not that some very good mammal photographs were not existent before the advent of handy high speed cameras and film. But most of those pictures were taken in zoos and showed nothing of the animal's native environment, or of its normal movements and actions. Moreover, while many excellent books of bird photographs have been published, there are hardly any comparable ones of wild mammals in their natural surroundings. But 'Mammals of the World' is now the answer. It is a worthy companion to Paul Barruel's 'Birds of the World' published a couple of years earlier. One appreciates that the selection of a representative lot of pictures cannot have been an easy task, since they cover not only all continents but also all groups of mammals, including those that live in the sea. The coloured photographs are attractive, but by no means the last word in colour reproduction, whereas the 216 black-and-white ones are truly superb, and certainly amongst the finest work of that type we have seen. Here again we have a number of M. Barruel's charming text-figures in line to illustrate some species of which satisfactory photos were not available, and it is no exaggeration to say that they give just the correct finishing touch to the general get-up of this sumptuous volume and to Dr. Bourliére's facile text. The chapter headings will indicate the book's coverage: What is a Mammal?; Mammals of the Tropical Forests; The Savannah and the Desert; Mammals of Temperate Forests and Prairies; Mammals of the Great North; Mammals of the Mountains; Aerial and Aquatic Mammals.

These two books together provide a sound and much-needed general survey of modern mammal study and the living mammals of today. In their own ways they complement each other admirably, and one could not wish for a better combination for any one who desires to consider himself, or be considered, well-informed about mammals. And for all who would understand the basic problems connected with wild life conservation and devise measures of practical value, these volumes are absolutely indispensable.

S.A.

4. PLANT ECOLOGY OF ARID REGIONS. Proceedings of the Montpellier Symposium. UNESCO, 19 Avenue Kleber, Paris (1955).

This volume contains papers by specialists from different countries in arid zone ecology and is designed to enable the UNESCO to prepare its arid zone research programme. The papers are grouped in four sections—(1) Structural and physiological nature of vegetation, (2) Climatic and ecoclimatic and hydrologic effects on vegetation, (3) Soil and vegetation and (4) Other factors—with an introduction by Dr. L. Emberger. These contributions are based on summaries of the present state of knowledge of arid zone ecology in different regions. The data provide a useful means of comparing conditions in arid regions of the world for the development of flora and fauna. More important than this, they bring out the urgent problems that need to be tackled in arid countries.

The classification of vegetation of arid zones is attempted from different angles. H. Boykoh gives methods to classify vegetation on climate. Pich Sermolli's method of classification is mainly physiognomical. Phylogenetic method for the classification of arid zone vegetation has also been suggested. Special studies include A.

Giacobbe's paper on the effect of Mediterranean climate on forest communities; the role of trace elements on vegetation by W. A. Roach; afforestation of arid areas by S. Ahmed. F. R. Bharucha has given an interesting paper on 'structural and physiological features of the Rajasthan desert'. Soil conditions in arid regions are studied by G. Lemee and J. M. Albareda. Microbiology is described by J. Nicot, C. C. Killian and H. Vargues. The entomological part is dealt with by F. Pierre.

The volume will be of immense value for ecologists in South-east Asia for the study of arid zones.

G. S. PURI

5. A GUIDE TO THE BIRDS OF CEYLON. By G. M. Henry. Pp. xl+432 ($8\frac{1}{2}'' \times 5\frac{1}{2}''$). 30 half-tone plates (27 coloured), 124 black-and-white drawings. Oxford University Press, 1955. Rs. 25.

The geological evidence that Ceylon is a lately detached fragment of the south Indian peninsula is fully supported by the general character of its fauna and flora. The wet, hilly south-western parts of the Island show close affinities with the humid portions of Travancore and Cochin, and its drier north-eastern parts are almost identical with the country lying on the opposite side of the shallow strait that now separates it from the south Indian mainland.

There is evidence that at least twice after the initial separation of Ceylon from southern India it was re-joined and again re-separated, the final disruption being in comparatively recent times—anything between 10 and 25 thousand years. These periodic connections provided the land bridges over which sedentary forms of animals immigrated from the Indian mainland. Evidence of successive 'waves' or 'invasions' of such newcomers can be convincingly traced in the present-day fauna of Ceylon, particularly in its bird life which has been critically analysed by recent investigators.

The result of thousands of years of isolation alternated by periodic reinforcement by fresh arrivals from the mainland, the strong Malayan element which the island shares with Travancore, and the well-marked divisions in its physiographical features have all combined to make the avifauna of Ceylon one of inordinate interest. It includes over 20 species of birds (6 genera) and something like 80 geographical races peculiar to the island, in some cases further differentiated into wet-country and dry-country forms. In the main, Ceylon races differ from their Indian counterparts in being smaller in size and darker in coloration, and also in the possession of heavier and/or longer bills. This last characteristic, curiously enough, is common to island forms in other parts of the world as well, but it has not been satisfactorily explained.

Due to its geographical situation, so near the Equator, the island possesses an equable climate, and such changes as occur in the seasons are governed mainly by the two monsoons, SW. and NE., which produce a wet season and a dry season in the areas under their respective influence. In the absence of a definite summer and winter the breeding seasons of birds are ill defined, and also seem to be governed largely by the monsoons.

This brief general background will be sufficient to explain why bird watchers in India no less than in Ceylon will welcome the long-awaited appearance of Henry's Guide, particularly now when there is a marked growth of general 'awareness' about birds in both countries.

The book is primarily offered as 'a means of identifying birds in the field with the help mainly of illustrations and concise descriptions, fuller in the case of some particularly interesting species'. We have no doubt about its being able to fulfil its purpose admirably. Henry's established reputation for excellence and accuracy as a bird artist, and his long familiarity with Ceylon birds in their native setting are sufficient guarantees.

It is not a little surprising that the author considers the note-book more important than binoculars as a 'bird studying tool'. It may be just a matter of opinion, but the reviewer feels this is rather like putting the cart before the horse, since it is seldom that an unfamiliar bird can be studied in sufficient detail with the unaided eye to make note-taking worth while.

The Introduction gives a historical sketch of Ceylon ornithology and a useful outline of the topography and vegetation of the island in relation to its bird life. A conveniently placed glossary before the descriptive portion, explains the technical terms and common Singhalese names occurring in the text, and should be of great help to the uninitiated reader.

The systematic order followed is that of the Fauna of British India and Wait's Birds of Ceylon. This 'anachronism' is no doubt due to the fact that W. W. A. Phillips's excellent Checklist was published when this MS. was already with the printers. The new Checklist follows the Wetmore arrangement which is now all the vogue, and claimed to be more up-to-date. While some may regret this accident of chronology, ornithologists who have grown up with the 'old-fashioned' order, in Ceylon as well as in India, will no doubt secretly feel thankful for small mercies!

Many of the author's original observations are of great interest. For instance, the female lorikeet carrying strips of the edges of green leaves for lining her nest cavity, with one end tucked under the rump feathers and flying off when a rumpful is collected, and the account of the courtship display of this species are quite novel.

The complete absence of vultures in Ceylon is difficult to understand considering the nearness of the island to the Indian mainland and the enormous cruising range and keen eyesight possessed by these birds which must enable them to survey vast tracts of country from the air and even to get a peep into Ceylon. Another curious anomaly is the absence of the Common Sandgrouse, seeing that the dry country in the north-east of the island is identical with, and practically adjoining, the drier parts of the southern peninsula.

Some very good notes are furnished on the Ceylon Junglefowl, including its nidification and the courtship display of the cock. Unfortunately the question is left untouched as to whether the species is monogamous or maintains a bevy of hens, as for instance the peacock does, or possibly in what has recently been termed 'successive polygamy'. This is still a moot question in regard to both our Indian species of junglefowl, and some definite information concerning their next-door neighbour would have been illuminating.

The author's remarks on the continuing deforestation of the island for cultivation and plantations and its adverse reflection upon bird life in general, and of the persecution for meat of all species large enough to be worth powder and shot, are dismal reading, but not unfamiliar in our own country. The increase of firearms, and the loosening of religious taboos against killing are given as two of the chief factors in the decimation of bird life to-day.

The replacement of inappropriate English bird names with more descriptive ones is a commendable step. For example, Longtailed or Jungle Nightjar for Horsfield's Ceylon Highlnd Nightjar for Kelaart's, and Bluefaced Malkoha for Greenbilled Malkoha are certainly more descriptive and rational.

309 of the 403 birds described in the Guide are illustrated, most of them in colour. They are of the well-known Henry standard of excellence, and form one of the chief features of the book. The more sobre-coloured birds are depicted in black-and-white drawings in the text, which are more variable in quality, some of them suffering from rather too heavy lines.

The handy end-cover maps, showing the wet and dry zones, orographical contours, and administrative divisions of the Island, are of great usefulness for ready reference.

Considering the overall sameness in the bird life of Ceylon and of the South Indian peninsula, the Guide will be found equally serviceable by bird lovers in both the countries; and not only by bird lovers, but it will be welcomed also by all who love well-illustrated and well-produced nature books that are a joy to handle.

S.A.

6. BUDGERIGARS FOR PLEASURE AND PROFIT. By Eric Leyland. Pp. 156 (7″ × 4½″). One black and white plate and 11 line illustrations. London, 1954. English Universities Press Ltd. 6*s*. net.

This is one of the series of 'Teach Yourself Books' and an excellent example of how much intelligent interest can be provided by, and work done in a hobby which to most people means little more than just keeping 'birds in a cage'.

Detailed instructions for suitable methods of housing budgerigars are given, but tropical countries like India perhaps do not present the same difficulties as in Europe. In India budgerigars are kept by many people because they do not need much space, and are relatively easy and inexpensive to keep. Little interest is taken here in scientific breeding or purity of stock, and birds are available at Rs. 10 per pair as compared with a price indication of £4 for stock birds.

These same birds can, however, be bred along more scientific lines, and the book should prove a valuable guide to those who would try. The diagrams and specifications of the cages are of particular usefulness, and Indian budgerigar fanciers will be enabled to derive much more enjoyment and profit from their hobby by following the suggestions offered in such simple and non-technical language. It is interesting to learn that a Budgerigar Society exists in England.

SHUMOON ABDULALI.

7. DWELLERS IN DARKNESS. An Introduction to the Study of Termites. By S. H. Skaife. Pp. x + 134, (15 × 22 cm.) 14 plates, 40 text-figures. London, 1955. Longmans, Green & Co. 25*s*.

This little book, which is the result of several years of careful study, deals in a very interesting semipopular style with the biology of the South African black-mound termite, *Amitermes atlanticus* Fuller. It is divided into fifteen chapters and is illustrated with several well-executed black-and-white drawings and some good photographs. After dealing with the methods of collection and study, the author gives the characteristics of the workers (called the 'slaves of the State') and the soldiers (called the 'guardians of the citadel'). The latter constitute only about five per cent of the adult population of the colony, and the workers the remaining ninety-five; in addition, there are the king and the queen and, in certain seasons, several winged reproductives which swarm out.

The mound, which is dome-shaped, attains a maximum size of about two feet in height and two feet in diameter. The maximum population encountered in a mound was about 40,000 adult individuals of all castes.

The growth of the colony, the rearing of the young ones and the mode of copulation are then briefly described. Copulation occurs only after the stimulus of the nuptial flight, without which the termites fail to pair. Several experiments were conducted on the feeding habits and it was found that the termites prefer *decayed* wood to all other types of food.

Two chapters deal with the 'guests' of the termite. First, with the so-called uninvited guests such as some small insects which habitually live and breed among the termite population in the nest without any apparent let or hindrance. Secondly, with the protozoa and bacteria which live in the alimentary canal and are believed to assist the 'host' in the digestion of cellulose; the protozoan species commonly occurring in the black-mound termite is *Nyctotherus silvestrianus*.

A chapter deals briefly with the various theories of caste formation in termites, and another describes the various types of 'observation nests' devised by the author for the study of living termites. At the end there is a short bibliography of the more common books on termites, mostly in the English language, and finally, an index.

Taken as a whole, the book is a welcome contribution not merely to the semipopular literature on termites in general, but also to the serious study of certain aspects of a species about which little was hitherto known. Perhaps the best sections of the book are those dealing with the population-structure of the colony, the nuptial processes and the food-preferences, and the weakest sections those concerning caste-formation and allied subjects where one wishes for more precise information.

The get-up and the printing of the book are excellent, but the price of 25 shillings appears to be excessive for so small a book. We nevertheless recommend the book to all students of social insects.

M. L. ROONWAL.

8. ANTS. By Derek Wragge Morley, M.A., F.L.S. Pp. xii + 179 (8″ × 6½″). 15 black-and-white plates, 50 line illustrations and maps, and a key for the identification of British Ants drawn by Alison Birch. London, 1953. Collins. The New Naturalist series. 18*s*. net.

How the author of this book became an authority on ants makes a remarkable story. Protracted illness and long convalescence reduced him as a boy of 14 to lonely inactivity in a garden chair, and the living ants around began to fascinate him. His interest grew and he started seriously studying the subject with remarkable success. In school his special talent was fortunately recognized and he was given opportunities to carry on what amounted to original research on ants, and at the age of 18 he had the unique distinction of reading papers before the 7th International Congress of Entomology at Berlin in 1938.

The first and third chapters, together about half the length of the book, are mainly concerned with the 27 species of British Ants, with short accounts of appearance, behaviour, habitat and food. The appendices contain maps showing the distribution of each species in the British Isles, as also a very useful diagrammatical key for the identification of each species, and forms within the species. It should not be supposed that the book will not be of interest to readers outside Britain. In India we who lack even a short book of Indian insects, leave alone of ants, are thankful for such a publication which is of interest to the general reader anywhere. There are chapters on 'The Growth of the Ant and its Anatomy', 'Ant Guests', 'Experimenting with Ants' and 'Collecting Ants'.

The naturalist interested in animal behaviour will find information scattered all over the book which will fascinate him, and will probably find the temptation irresistible (even at the risk of being shunned by the respectable as an anthropomorphist) to see in insect behaviour much that is of significance to our own social setup.

The varieties and aberrations of ant societies are many and instructive. On p. 39 we read about the Thief Ant. These tiny creatures build their minute galleries in the nests of larger ants. They live by stealing food from their large hosts, who cannot enter the tiny galleries and make reprisals. Look to the ant, thou sluggard!

On p. 73 one learns the depressing fact that some nests of the Blood-red Slave-making Ant contain a large number of workers of the Large Black Ant. These workers 'are acquired by the Blood-red Slave-makers by means of slave raids on the neighbouring nests of the Large Black Ant, in which they steal the cocoons of the Large Black Ant. The cocoons then hatch out into workers of the Large

Black Ant which never having known any other nest odour . . . quite happily accept the mixed nest as their true home. These Large Black Ant workers will even take part in slave raids on their own mother colony, fighting fiercely beside their colleagues, the Slave-makers'.

The integrity of nests is maintained by distinctive nest-odours which help individuals to reject others even of their own species belonging to alien nests. Yet it happens that species differing conspicuously in appearance and habits are found together in a common nest most often as parasite and host. The Jet Black Ant is a large dairying tree dweller; the Yellow Ant is a dark-loving troglodyte. Yet the fertilized queen of the Jet Black Ant by somehow simulating the nest-odour of the Yellow Ants insinuates herself into their nest and starts producing young which are tended by the yellow hosts who gradually dwindle in numbers. Most strangely the dark-loving troglodyte hosts change their instinctive behaviour, and in association with their dominant tree-dwelling guests are 'found happily climbing high on the sycamore trees exposed to the full glare of the sun in order to milk the green flies and other plant lice which are pastured there'.

One may however refuse a pang of pity for the poor obliterated Yellow Ant, for often in turn it is itself parasitical upon a third species, the Common Black Ant. The queen of the Yellow Ant celebrates her nuptials by capturing a worker from a nest of the Common Black Ant. She goes off on her marriage flight with the half-dead worker in her jaws and ultimately devours it. This strange marriage custom is not just a coarse untimely manifestation of an over-exuberant appetite. It has a subtle, sinister purpose, for thereby the fertilized queen acquires the nest odour of the Common Black Ants, and enters their nest to live and multiply on the labours of the hosts, which are then gradually supplanted.

The author has experimented on the learning abilities of ants by running them through mazes, and has incidentally discovered that even a lowly ant will collapse in convulsions symptomatic of a nervous breakdown when a maze pattern that it has mastered is changed by unexpected and insurmountable obstacles. It has been found that there is much individual variability in learning behaviour, and that the better-learning ants are more prone to such nervous breakdowns. It is believed that these better learning ants are the ones that initiate the various operations in an ant colony. In most worker ants there is no instinctively set division of tasks. But these exceptional individuals start doing a particular job and their activity excites others immediately round them to do likewise.

The author concludes the book with the hope (p. 118) that the reader may not find himself 'lost and forlorn in his brief excursion into an alien world'. One is afraid this hope is not quite fulfilled as the general reader feels he is rushed into a wild, strenuous whirlwind tour of the 'alien world' and wishes the learned author had been more considerate and taken him on a gentler and more methodically conducted excursion.

D.J.P.

## ADDITIONS TO THE SOCIETY'S LIBRARY

The following books have been added to the Society's Library since December 1955:

Review copies:

1. African Handbook of Birds, Series One: Birds of Eastern and North-eastern Africa, Vol. I. By C. W. Macworth-Praed and Capt. C. H. B. Grant (Longmans, Green & Co. Ltd., London, 1952).
2. African Handbook of Birds, Series One: Birds of Eastern and North-eastern Africa, Vol. II. By C. W. Macworth-Praed and Capt. C. H. B. Grant (Longmans, Green & Co. Ltd., London, 1955).
3. Bird Navigation. By G. V. T. Matthews (University Press, Cambridge, 1955).
4. A Guide to the Birds of Ceylon. By G. M. Henry (Oxford University Press, 1955).
5. Budgerigars for Pleasure and Profit. By Eric Leyland (The Teach Yourself Books—English Universities Press Ltd., London, 1954).
6. The World of small Animals. By T. H. Savory (University of London Press Ltd., 1955).
7. The Natural History of Mammals. By François Bourlière. Translated from the French by H. M. Parshley (George G. Harrap & Co. Ltd., London, 1955).
8. The Mammals of the World—Their Life and Habits. By François Bourlière. Translated from the French by H. M. Parshley (George G. Harrap & Co. Ltd., London, 1955).

Purchased:

1. Trailing the Tiger. By Mary Hastings Bradley (D. Appleton & Co., New York: London, 1929).
2. Bullet and Shot in Indian Forest, Plain and Hills. By C. E. M. Russell (W. Thacker & Co., London, 1900).
3. Nilgiri Sporting Reminiscences. By An Old Shikarri (Higginbotham & Co., Madras, 1880).
4. Elephant and Seladang Hunting in Malaya. By T. R. Hubback (Rowland Ward Ltd., London, 1905).
5. Jungle Trails and Jungle People. By Caspar Whitney (T. Werner Laurie, London, 1905).
6. Wild Men and Wild Beasts—Scenes in Camp and Jungle. By Lt.-Col. Gordon Cumming (Edmonston & Douglas, Edinburgh, 1871).
7. A Soldier's Shikar Trips. By Brig.-Gen. H. G. Mainwaring (Grant Richards Ltd., London. 1920).
8. Past Days in India or Sporting Reminiscences of the Valley of the Soane and the Basin of Singrowlee. By A Late Customs Officer (Chapman & Hall, London, 1874).
9. Sir Victor Brooke: Sportsman and Naturalist. By Oscar Leslie Stephen (John Murray, London, 1894).
10. Forest Life and Sport in India. By Sainthill Eardley-Wilmot (Edward Arnold, London, 1910).
11. Letters on Sport in Eastern Bengal. By Frank B. Simson (R. H. Porter, London, 1886).

12. THE FOREST AND THE FIELD. By H. A. L., The Old Shikarri (Saunder, Otley & Co., London, 1867).

13. BIG GAME SHOOTING IN INDIA, BURMA AND SOMALILAND. By Col. V. M. Stockley (Horace Cox, London, 1913).

14. INCIDENTS OF FOREIGN SPORT AND TRAVEL. By Colonel Pollock (Chapman & Hall Ltd., London, 1894).

15. BIG GAME HUNTING IN MANCHURIA. By N. Baikov. Adapted from the Russian by Serge Ivanoff and Gertrude Mack. [Hutchison & Co. (Publishers) Ltd., London, 1936.]

16. MODERN PIG-STICKING—II Edition. By Lt.-Gen. Sir A. E. Wardrop (Macmillan & Co. Ltd., London, 1930).

17. MY BIG-GAME HUNTING DIARY. By Count Henrik Apponyi (Selwyn & Blount, London, 1937).

18. THE RIFLE IN INDIA. By Lt.-Col. L. L. Fenton (W. Thacker & Co., London).

19. ON HILL AND PLAIN. By Lord Hardinge of Penshurst (John Murray, London, 1933).

20. TIGERLAND—Reminiscences of Forty Years' Sport and Adventure in Bengal. By C. S. Gouldsbury (Chapman & Hall Ltd., London, 1915).

21. THE OUT-STATION OR JAUNTS IN THE JUNGLE. By James Williams Grylls (Chapman & Hall Ltd., London, 1848).

22. IBEX SHOOTING ON THE HIMALAYAS. By Major Neville Taylor (Sampson Low, Marston & Co. Ltd., London, 1903).

23. SPORT IN BENGAL AND HOW, WHEN AND WHERE TO SEEK IT. By Edward B. Baker (Ledger, Smith & Co., London, 1887).

24. SPORT IN JHEEL & JUNGLE. By K. N. Chaudhuri (Thacker, Spink & Co., Calcutta, 1918).

25. THE LIFE OF AN ELEPHANT. By S. Eardley-Wilmot (Edward Arnold, London, 1912).

26. THE DIARY OF A SPORTSMAN NATURALIST IN INDIA. By E. P. Stebbing (John Lane Co., The Bodley Head, New York, 1920).

27. BEES. By I. Khalifman (Foreign Languages Publishing House, Moscow—Translation from the Russian. 1951 edition: 1953).

28. BIRDS OF THE NORTH. By Bengt Berg (P. A. Norstedt & Sönner, Stockholm, 1925).

29. THE PRESERVATION OF NATURAL HISTORY SPECIMENS, Vol. I—Invertebrates. By Reginald Wagstaffe & J. Havelock Fidler (H. F. & G. Witherby Ltd., London, 1955).

30. RECENT STUDIES IN AVIAN BIOLOGY. Edited by Albert Wolfson (University of Illinois Press, Urbana, 1955).

Presented:

1. NOTES ON THE ANIMALS (Mammals, Birds and Reptiles) OF MESOPOTAMIA. Bombay Natural History Society, 1916 (Photostatic copy sent by Robert T. Hatt, Director, Cranbrook Institute of Science, Bloomfield Hills, Michigan, U.S.A.).

2. STUDIES ON THE GAMOPETALOUS PHANEROGAMS OF KRISHNAGIRI NATIONAL PARK, BORIVLI. By Miss Aban Jehangir Randeria, St. Xavier's College, Bombay, 1954 (Thesis for the Degree of Master of Science in Botany of the University of Bombay).

# MISCELLANEOUS NOTES

## 1. ACCIDENTS TO TIGER AND PANTHER

The following two incidents will undoubtedly interest your readers. I think they are well worth recording.

Immediately after cattle had been driven into the labourers lines by the herdsmen one evening, a woman was drawing water in a bucket from a well close to the road where the cattle had just passed.

She had just raised the bucket of water and was pouring it into her pail, when a ¾ grown tiger sprang clean over her head and disappeared down the well!

Neighbours nearby saw this and went to the well where the tiger was standing on his hind legs, with his head out of the water. Soon afterwards it was shot by the European in charge of the Estate. The tiger had evidently followed up the cattle and for some reason had mistaken the woman for one of the animals.

Anyhow, it is most unusual for a ¾ grown tiger to be a maneater. It was indeed lucky for her that she had simultaneously stooped to pour the water into her pail as the tiger sprang.

The woman was unable to speak for two days, but after a good peg of whisky she soon commenced to talk and her husband said she talked all right!

The second incident is that of a full grown leopard being found dead in a drain near the labourers' lines with a domestic cat in its mouth. Both were dead.

Obviously the leopard had attacked the cat whose head was in the leopard's mouth. On closer examination it was discovered that the cat had bitten through the leopard's wind pipe and there were claw marks through the tongue—Hats off to the cat!

Dikal Camp,
Darrang, Assam, FRANK NICHOLLS
*January* 6, 1956.

## 2. SLEEPING DOGS

In his customary Nature Notes in the *Daily Telegraph,* M.B. (a well-known naturalist-writer) questions whether when a domestic dog walks round and round before settling down it is because its wild ancestor did so. He remarks that even in domestic dogs it seems not to be a common habit. Making enquiry of various dog owners he received various replies, but two particular views were given frequently. The first was that dogs are less prone to this particular trick than they used to be. The other was that this circling action is most noticeable in kennel-kept dogs. In common with a large number of sportsmen who have kept dogs in India for 'Bobbery Pack' purposes I can recollect that the circling habit before lying down was fairly common among them. But I kept no notes on the matter. 'Perhaps' says M. B. 'our ancestors were responsible for it (the circling habit) rather than the dogs'.

The purpose of this note is to invite those who can throw light on the subject to do so.

c/o Lloyds Bank Ltd.,
39 Piccadilly, W. 1, R. W. BURTON,
*December* 11, 1955. *Lt.-Col.* I.A. (Retd.).

## 3. THE BROW-ANTLERED DEER OR THAMIN (*PANOLIA ELDI THAMIN* THOMAS) IN THE UNION OF BURMA (1955)

The thamin has been declared a completely protected animal under section 6 of the Burma Wild Life Protection Act, 1936, vide Ministry of Agriculture and Forests Notification No. 237 dated the 16th August, 1955.

### Distribution

A survey was conducted by the Conservators of Forests, Northern Circle and Chindwin Circle in their respective circles during 1954. On request by the writer, the Conservators of Forests, Hlaing and Sittang Circles carried out a similar survey in their circles during the current year (1955).

### Northern Circle

West-Katha Division:

There are approximately about 100-150 animals in the unclassed forests along the villages of Ye-Oh, Aingyi-le and Ohne generally known as Phalekwin comprising an area of about 20 square miles and situated in the south-west corner of the Division. The habitat is scrub Indaing jungle dotted with grass patches.

East Katha Division:

About 200 animals are in existence in the Division. They are found in all dry places under scrub forests with patches of grass from the foot of Tagaung Hill towards Shwebo Division in the unclassed forests and situated round about Tagaung, Magyigon, Mingon, Kyarhnyat, Pauktabin, Twin-nge and Thabeikkyin along the Irrawaddy covering an area of about 50 square miles in the southern part of the Division.

Shwebo Division:

The estimated numbers now in existence are as follows:

| | |
|---|---|
| Shwebo Range | 300 |
| Kanbalu Range | 300 |
| Thaw Range | 600 |

The range of this species covers all scrub indaing areas, especially those now constituted as fuel reserves—Thityabin, Thaw and Kyaikthin reserves lying between the Mu river and Mandalay-Myitkyina railway line, Kyaikthin Fuel Reserve and the surrounding unclassed forests have been constituted as a Thamin Game Sanctuary. Most of the thamin are to be found in this sanctuary. Estimates are prepared from information collected from local villagers.

There are still a fair quantity of thamin distributed along the Mu Valley and also on the east of the Irrawaddy River in the dry scrub forests, and there is at present no anxiety as to its extinction. There is no doubt, however, that as soon as conditions permit, steps should be taken to appoint game staff to prevent further extermination of these rare animals. (Letter dated Maymyo, 5th June 1954 from U Thein, Conservator of Forests, Northern Circle.)

### Chindwin Circle

| | |
|---|---|
| Lower Chindwin Forest Division: | 300-400. |
| Yaw Forest Division | 60. |
| Minbu Forest Division | 300. |
| Meiktila Forest Division | 300. |

(Letter dated Maymyo, the 14th July, 1954 from U Mya, Conservator of Forests, Chindwin Circle.)

### Hlaing Circle

| | |
|---|---|
| Insein Forest Division | Nil. |
| Tharrawaddy Forest Division | Nil. |
| Zigon Forest Division | About 30.<br>In Satthwa Reserve.<br>About 25-30. |
| Prome Forest Division | Thamin moving in groups of 7 or 8 in Tonye Reserve just about 10 miles north of Prome. |
| Thayetmyo Forest Division | About 200.<br>In scrub jungle between the eastern watershed of Panichaung and Irrawaddy River. |
| Allanmyo Forest Division | About 300-500.<br>In small groups of 4 or 5 in unclassed forests which is mostly 'Indaing'. |

(Letter dated Rangoon, the 21st October 1955, from U Ne Win, Conservator of Forests, Hlaing Circle.)

### Sittang Circle

| | |
|---|---|
| Yamethin Forest Division | 15 |

A small herd of 6-7 animals seen occasionally near Yan-Aung, south-west of Pyawbwe.

A few pairs occasionally seen about four miles west of Hgnetthaik Railway Station.'

(Letter dated Rangoon, 7th November 1955 from U Thein Han, Conservator of Forests, Sittang Circle.)

Shwebo Forest Division:

In September 1952, an old Forest Ranger, resident of the area, gave the following estimate:

| | |
|---|---|
| Shwebo Range | 400 |
| Kanbalu Range | 300 |
| Thaw Range | 600-700 |

The Divisional Forest Officer gave the following estimate in September 1955:

| | |
|---|---|
| Kyaikthin Wild Life Sanctuary | 500 |
| Shwebo Range | 150 |
| Kanbalu Range | 250 |

Kyaikthin Wild Life Sanctuary is situated in Thaw Range. The Divisional Forest Officer has not given an estimate of animals outside the sanctuary.

Minbu Forest Division:

The estimate of 300 animals was made in 1954, before the re-occupation of Shwezettaw Wild Life Sanctuary in March 1955. As 250 thamin are now reported inside the sanctuary, there may be more than 50 animals outside the sanctuary.

Thayetmyo Forest Division:

In October 1947, the Divisional Forest Officer gave the same number 200 for the Panichaung area, and from 20-30 animals in the Kama area. A few thamin have also been reported from Ngarmyetnar, Padaung Township. The present estimate does not appear to include the animals in the two areas.

## GENERAL OBSERVATIONS

Lt.-General A. F. Phillip Christisen and Lt.-Col. Edgerby were surprised to come across thamin on two or three occasions during the campaign in Arakan from the autumn of 1943 to May 1945.

Lt.-Col. Edgerby who knows the thamin well, thought it strange to find it on the west coast.

'They seem scarce and very local and confined to the low ground and coastal foothills on either side of the Indo-Burma border where the country in winter is dry and the jungles scrubby and open with grassy hillocks, "Khunai" grass growing on the foothills.' *JBNHS*, Vol. 45 (4) December 1945. Owing to unsettled conditions in the area recent information is not available.

The Arakan Yoma is a natural barrier. 'Thamin from Minbu Forest Division could not possibly have crossed over the Yoma into Arakan. It is therefore possible that the "Thamin" seen by Lt.-General Phillip Christisen may be *Panolia eldi eldi* MacClelland; which had wandered into Arakan from East Pakistan. In his article on The Larger Deer of British India, R. I. Pocock gives the distribution of *Panolia eldi thamin* Thomas as Upper Burma and Lower Burma including Tenasserim; also Siam and probably the Malay Peninsula.' *JBNHS* Vol. 43 (4)—April 1943.

The writer was on a shooting holiday from the middle of March to the middle of May in 1910 on the Tenasserim River. Though he saw large herds of sambar, he never came across any thamin. Neither did he hear of it.

Again in 1914, the writer was on a shooting holiday in the Thayetchaung Township, Tavoy District, during the college summer vacation. No thamin were seen.

I personally doubt if the range of 'Thamin' extends beyond Martaban. This view is strengthened by the following extract from 'Notes on the Fauna, Flora and Minerals of Tenasserim, Pegu and Burma' by Rev. F. Mason, (Stephens Austin & Son, Hertford, 1882). 'Their habitat and range according to Mr. Davis are as follows: In the Martaban District they inhabit exclusively the open grassy plains between the sea and the mountains. In the Pegu plains they are perhaps more abundant than in any other part of Burma; next to them the Yengyaung plains in Martaban produce most; near Rangoon, they are found in the Dallah plain. About Pegu and Yengyaung they are found in herds from fifty to a hundred in the month of March, but when hunted they congregate much more and as many as two hundred may be seen together.'

### CONCLUSION

There are now approximately 3,000-3,500 thamin in the Union of Burma. *Panolia eldi thamin* Thomas cannot now be said to be a vanishing species. But, as pointed out by the Conservator of Forests, Northern Circle, early appointment of game staff to protect it from further extermination is essential. It is hoped that the Ministry of Agriculture and Forests will not stop at declaring thamin as a completely protected animal, but will continue to see that there is no further illicit shooting of thamin, the beautiful and typical deer of Burma.

RANGOON, U TIN YIN, B.C.S. (Retd.)
BURMA.

[U Tun Yin has since informed us that by the subsequent Wild Life Protection (Amendment) Act of 1956 the Government of the Union of Burma has declared the thamin a completely protected species along with rhinoceros, tapir argus pheasant, masked finfoot and peafowl.—EDS.]

## 4. THE LEAF MONKEY OF KASHMIR VALLEY[1]

Pocock (1939), Fauna of British India, Mammalia, Vol. I, p. 96 was not sure of the identity of the leaf monkey found in Kashmir and he doubtfully included this locality in the distribution of two forms, namely, *Presbytis entellus achilles* (Pocock) and *P. e. ajax* (Pocock) without citing any authority.

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[1] Published with the permission of the Director, Zoological Survey of India.

While with a field party of the Zoological Survey of India in June 1955, I came across a large troop of leaf monkeys on the hills just behind Nishat Garden about eight miles north-east of Srinagar. There were about fifty individuals in the troop which probably included a number of family parties. The altitude at which they were found was about 8,000 ft. That this leaf monkey frequents places of similar or higher elevations was confirmed by a number of reports from the local people also. Although no specimen could be obtained, yet it was possible to observe some individuals at a very close range and identify them to be *P. e. ajax*.

The troop was busy eating wild fruits. A few individuals hurled stones[1] when a shot was fired. It appears to be quite an inquisitive and a bold animal, some old individuals even threatening to charge.

ZOOLOGICAL SURVEY OF INDIA,
INDIAN MUSEUM,
CALCUTTA,
*August* 18, 1955.

H. KHAJURIA

## 5. LONGEVITY OF THE CEYLON RUDDY MONGOOSE (*HERPESTES SMITHI ZEYLANICUS*) IN CAPTIVITY

Further to my note which was published in the *Journal* in 1954 [Vol. 52, (2 & 3) page 587], I now write to record that the mongoose in question died on the September 8, 1955, aged approximately 17 years and 11 months. It ate quite well right up to the last day and died peacefully during the night, apparently of old age and/or heart failure.

TONACOMBE,
NAMUNUKULA,
CEYLON,
*November* 7, 1955.

W. W. A. PHILLIPS

## 6. TUFTED DEER IN BURMA

With reference to U Tun Yin's very interesting note on 'Tufted Deer in Burma', in Vol. 53, pp. 123-125 of this journal, mention of 'black barking deer' in Northern Burma was not, unfortunately, confined to newspaper accounts of the Vernay-Cutting expedition. Mr. Cutting himself published an account of this expedition in 'The Fire Ox and Other Year' (London, 1947) and wrote as follows (pp. 318/19):

> 'Now came a big moment in the history of the expedition. Returning to camp one evening, empty-handed, we saw a Lisu crouched over the dark form of a little animal. It was a deer with

---

[1] ? Or was it not perhaps the accidental hurtling of loose stones down the hillside, caused by the flight of the langurs on the report of the gun?—EDS.

> prominent teeth and curved antlers, and its colour was a smoky-gray of a uniform shade. This was the famous crested muntjac: the black barking deer had turned out to be smoky-gray. The American Museum of Natural History would be the first to possess a specimen . . . .
>
> The smoky-gray deer was in good condition, we were happy to discover, and the newspaper correspondents would now be at liberty to call the expedition a success. Actually, its success or failure did not depend on one specimen, however important, but not one of us would have feigned indifference to the vagaries of those who had made this a barking-deer expedition. Anyway, there it was on the ground before us, the prize for which we had worked and struggled.'

An excellent photograph of the dead animal and its Lisu hunter is printed in the book. Mr. Anthony's notes now make it clear that this was merely another example of the Tufted Deer.

In 1948 I found it to be common in the Chimili area, where it was wont to come out singly early in the mornings to graze on open grassy areas below the snow-line at 8,000-9,000 ft. The Lisus in this area had no superstition about hunting them with cross-bows and arrows, and I purchased one so killed; the skin and skull were presented to the British Museum (Natural History), whose only other specimen from Burma was the one presented by Capt. Maxwell West. I failed to find this deer in the upper N'Mai Hka or its tributaries the Ahkyang and the Taron, nor has anyone else yet recorded it north of the Chimili on the Burma side.

FOREST OFFICE,
BRUNEI,
SARAWAK,
*November* 3, 1955.

B. E. SMYTHIES

## 7. EXPERIMENTS IN IMPLANTING AFRICAN LIONS INTO MADHYA BHARAT

The lion in India used to be fairly common in the jungles now included in Rajasthan and Madhya Bharat. It is unfortunate that it is not found any longer in the country except in the Gir forest situated in Saurashtra. The reason for its disappearance is the tiger which kept on increasing in number and killed off or drove away the lion until it found an asylum in the Gir forest. This forest is an isolated area completely cut off by over a hundred miles from the tiger infested hills. The tiger is the kind of animal which does not allow other large carnivora feeding upon the same food to live in the same locality. It is like the case of having two swords in one scabbard.

The tiger seems to have come to India from China, Assam, Burma etc., through Bengal, and that is the reason why it is still called Bengal tiger. It was more cunning and powerful than the lion and therefore it killed off or drove the lion away from the areas it occupied.

I had a few opportunities to arrange duels between the lion and the tiger in a small arena specially prepared for the purpose. In three such experiments on three different occasions I found the same result. It is the lion that always makes the first attack and it is he who gets the worst of it. One or two smacks from the tiger are enough to make the lion retire.

The late Maharaja Sir Madho Rao Scindhia, realizing that lions had existed in his State (Gwalior) in the olden days, resolved to re-introduce them. With this object he imported three pairs of lions from Africa. The jungle selected was Sheopur and Shivpuri forest range, which covered an area of some 1,000 square miles.

When these animals arrived they were taken to a place called Dobe Kund which is practically half way between Sheopur and Shivpuri. A special enclosure of stone wall, 20 ft. high, was prepared, in which the lions were kept. They were not fed on dead meat but were always provided with live buffaloes so that they might not lose the natural habit of killing animals. They were kept in this enclosure for about 4 years during which they not only got thoroughly acclimatized, but also bred and increased in number.

This place was situated in a lonely spot in the midst of forest abounding in tigers. The roaring of the lions always attracted the wild tigers, but on account of the high wall they could not get at them. We used to make periodical inspections of the place, and twice I came across tigers lying about in the vicinity of the enclosure—they probably came to challenge the lions!

We did not let out all the lions at the same time, but they were released in pairs. The first pair which was let out in August 1920 gave us no trouble, but vanished in the wilderness. But when the second pair was let out, the animals came back again and made their home outside the enclosure. They caused great alarm among the men who went there with a supply of their food. They attacked and snatched away the buffalo from their hands. Fortunately they did not kill any man but they simply took the buffalo and started feeding on it there and then.

On getting this news we got rather worried; so the next day we went there in a party and drove them away from the enclosure. Since there were some more lions left in the enclosure a regular supply had to be sent for their feed. The next day when the shikaris went with a fresh buffalo they found the male lion lying dead with his body badly mutilated, showing that he had been killed by a tiger. The lioness was not seen anywhere in the vicinity. What had apparently happened was that this pair on being driven away must have come across some tiger in the jungle who must have killed the lion, and the lioness must have escaped.

The third, fourth and fifth pairs gave us no trouble, but when the sixth and the last pair was let out after two months they proved most troublesome. They adopted the easiest method for getting their food. The forest in this part is very thinly populated having no big villages but just a few scattered hamlets. The poor villagers do not possess any fire-arms. The pair of lions made the habit of going to these hamlets and helping themselves to any cattle they could kill and eat on the spot. The villagers, to protect their animals, built stronger fences.

The next time the pair visited the village, they could not get through those fences and therefore they killed a man instead and devoured him. As soon as this news was brought to us we rushed to the spot and destroyed the animals.

Most of the five pairs that vanished into the wilderness went a long way east and south. A few cases came to my knowledge of these lions having been actually shot near Panna and Jhansi in the east, and some at Kotah in the south. The late Maharaja of Baria shot one of them a few years ago along the bank of Kunoo River in Madhya Bharat.

I was glad to read in the newspapers that there is a proposal to re-introduce the Indian lion from the Gir forest into some other parts of our country, so that the species may not get extinct. If this idea is under serious contemplation, I suggest that the authorities should select isolated forests in which there are no tigers. Rajasthan is one of the suitable provinces where one can find such isolated jungles. It is most desirable to make this experiment, because very few Indian lions are left in the world, and if they die the species will vanish with them.

Where sport is concerned it is far more interesting and exciting to shoot a tiger than a lion. The tiger requires comparatively elaborate arrangements to be made for a successful shoot, and sometimes even after all such arrangements and precautions there is every possibility of his giving one the slip. He is infinitely more cautious than the lion.

In the summer of 1952 I accompanied the Maharaja of Jaipur who went for a lion shoot in the Gir forest in Junagadh. All shooting arrangements were organised by H. H. The Jam Sahib of Nawanagar. The very next day after our arrival a beat was organised in which two lions came out together out of which one was shot. Another beat was organised the next day in which another lion was shot.

I was surprised to notice that in neither case did the lion attempt to make any use of cover. He came out boldly as if taking a stroll, offering an easy target to the sportsman. Once he is wounded he is certainly as bold as the tiger.

There is a great difference between the habits of these two animals as well. A lion uses his paws to strike his adversary, whereas the tiger uses them mainly for holding down his victim. Lions live in a 'pride' consisting of a large family, whereas the habit of the tiger in this respect is just the opposite. Lions do their hunting by team work which tigers rarely do. The lion is comparatively weaker but bolder, and he is not half as cunning as the tiger. If a tiger is accompanied by a tigress and cubs it is the tiger who tackles the kill first, and he has his fill before allowing any member of this family to touch the food. But in the case of the lion, and also the panther, it is the female who does the killing and eating, while the male joins her later on. To put it in nut-shell a tiger has more of the Indian habit in this respect than the other animals!

Lions should certainly be increased not only to save them from extinction but also for providing a variety of big game shooting in India, although it is much more fun, and also more difficult, to shoot a tiger.

In conclusion I must state that our implanting experiments were more of a success than a failure. The very fact that H. H. The Maharao of Kotah, and the Maharajas of Panna and Baria have shot these lions in comparatively recent years, suggests the possibility that they may still be surviving in remote areas away from the haunts of the tiger.

NARAIN NIWAS, KESRI SINGH,
JAIPUR (RAJASTHAN), *Colonel.*
*October* 26, 1955.

## 8. WESTERN LIMITS OF TWO EAST HIMALAYAN BIRDS

While in Landour recently I had the opportunity of examining a specimen (♂) of Gould's Shortwing, *Brachypteryx stellatus* Gould, collected by Master Robert Fleming at Dhodi Tal, 11,000 ft. altitude, 70 miles due north of Mussoorie, on 7-6-1953. The hitherto known distribution of this species was Nepal, Sikkim, Bhutan and South Tibet bordering Bhutan.

I also examined a specimen of the Striped-throated Yuhina, *Yuhina gularis gularis* Hodgson, collected by him at Jabarkhet, Mussoorie (*ca.* 6,000 ft.) on 9-3-1953. The Fauna gives the distribution of this as 'Nepal to eastern Assam north of the Brahmaputra'.

These specimens, therefore, represent a considerable westward extension of the known ranges. Remarkably enough both of them were killed by Master Robert with an air-rifle!

33, PALI HILL, SÁLIM ALI
BANDRA, BOMBAY,
*January* 13, 1956.

## 9. A DABCHICK IS BORN

In the game of bird photography both sides often follow the same tactics: the ardent photographer, having found a nest, retires into his 'hide' and waits for the return of its owner; the wily bird, noting the carefully camouflaged excrescence which has suddenly grown from the ground, retires into the jungle and waits for the departure of the photographer. And so, things being as they are, the consequences are as inevitable as the philosophers say they will be, namely unexposed films, unproductive hours, and unavailing labour.

The Little Grebe or Dabchick (*Podiceps ruficollis*) is expert at playing this game of patience, for it will vanish into the reeds, in the midst of which it makes its home, without leaving behind so much as a ripple on the water, and yet it will not go so far away as to deprive the photographer, steaming in his hide, of the trilling sound of its mocking laughter. At such moments, the photographer is apt to forget his biological training and call it 'a regular swine'.

In the summer of 1944 I was in Kashmir and planned to photograph, among other birds, the Little Grebe; I hoped for success of course, but expected none, and my expectation was largely fulfilled!

The first nest found was the usual 'pad of weeds' in the middle of a small weed-grown, water-filled 'nullah' not far from the lower reaches of the Sind River. A willow overhung the bank and trailed long slender fingers in the water and about the nest, whose top was covered with wet weeds carefully left in place by the retreating parent-bird in an attempt to conceal the four mud-stained eggs. I buttoned myself into my hide and prepared to wait. A shrike, whose nest was placed in a split limb of the willow tree, was the first to return, its aggressive call leaving the listener in no doubt as to its nearness. A cuckoo with the smooth, self-assured voice of one who knows he will get the better of you, called and chuckled from a nearby plane tree. His presence caused a violent stir among the shrikes. Innumerable doves moaned in the tree-tops.

A dabchick once emerged silently from the dark water and appeared beside the nest—a quick look at the hide and the telephoto-lens pushing through and it was gone again, making as it went a sound no louder than the splash of a little fish coming up for a fly. Time passed: hordes of caterpillars, hairy and dark, invaded the hide; voracious mosquitoes stung the patient watcher in those parts of his person where his trousers were stretched tightest; but never again did the dabchick return.

That was the first of many fruitless days. The nest in the 'nullah' was abandoned and the scene of operations shifted to Anchar Lake. This is a large shallow lake to the north of Srinagar which is filled with vegetation. The flowering time of the white water-lilies was over; the lotus had not yet begun to bloom, and only their broad leaves, still tender and the colour of dull bronze, reached out of the water towards the sunshine. Brushed by a boat the wide wheels revolved against the sides and twisted back into place once the boat had passed. Sometimes the leaves passed under the keel of the boat and would reappear each with a drop of water on it and magically, it seemed, clear water in the new association became clearer and more beautiful still. The edge of the lake is guarded by the close-serried ranks of tall reeds, the height of a man, and among them the second nest was found.

Here again many fruitless hours were spent and patience began to ooze out of me even as did my sweat. The trilling laughter of the dabchicks mocked me incessantly. At last my patience was exhausted, and I determined to abandon the vigil when a shikari, picking an egg up in his hand, discovered that it was cracked and the chick about to break through. Back excitedly once more into the hide, this time with great expectations! For a while nothing happened. The sun moved steadily westwards and cast evening shadows on the base of the reeds. Suddenly the crack in the egg widened perceptibly and from within issued a loud cheeping, clearly audible from the hide 15 ft. away. A parent bird which so far had only shown glimpses of itself now pushed a small, excited, snake-like head through the reed stems, first from one side, then from the other, but it was still too frightened to approach the nest. Another pause. Then with a mighty heave the young chick broke free from its prison-shell and appeared in all the glory of its striped coat. The adult again appeared, and this time throwing caution to the winds, flopped clumsily like a seal out of the water on to the nest. There was no sign of the second parent bird.

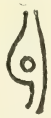
The adult tried hard to incubate the newborn young and the remaining three unhatched eggs. The chick, however, was too lusty a youngster, even at his age (but a minute or two old !) to submit thus to parental authority; instead he clambered from side to side inspecting every corner of the nest, once or twice nearly falling into the water. The parent bird persisted in its attempts to incubate, but being totally unable to cope with Junior's encircling moves, trod clumsily on him. Junior squeaked a protest, but still took no notice of the breast feathers fluffed out to receive him. This game of catch-me-if-you-can went on for fifteen minutes or so with parental anxiety gradually reaching fever-pitch. Suddenly there came from the thick forest of reed-stalks a warning trill from the second parent.

The events that followed happened swiftly and with the precision of a well-rehearsed manoeuvre. The warning was not repeated, nor did the adult bird in the nest utter any audible sound. Nevertheless the chick understood the signal and played his part without apparent instruction. At the sound of the warning call the clumsy parent scrambled off the eggs which it had been incubating and went to the edge of the nest furthest away from me. It squatted down and lowered its vestigial wings. The chick, which at this moment was investigating the far north-western corner of the nest, immediately left off exploration and made towards his waiting steed at a rapid crawl. Unaided by the adult bird, he then proceeded to clamber up its back and once he was safely ensconced the parent bird got up on its feet, folded its wings into place and quietly and rapidly slid into the water. In an instant they were gone, not to be seen again.

CATHAY BUILDING, LOKE WAN-THO
SINGAPORE,
*January* 14, 1956.

[Unfortunately the photo is underexposed and will not reproduce satisfactorily. It was taken, Mr. Loke points out, in war-time when materials were scarce, and the film used for the picture was so old that even four times the normal exposure proved insufficient !—EDS.]

## 10. CROWS AND WEAVER BIRDS — RATIOCINATION OR WHAT?

While living in Balloopur, near New Forest in Dehra Dun, U.P., a few years ago, I had under close and regular observation a colony of Baya weaver birds (*Ploceus philippinus*)—*ca.* 50 nests in all—on an isolated tall date palm some 150 ft. from the window of my study. Binoculars lay handy at all times so that routine happenings at the colony could be observed, and any unusual agitation or commotion followed immediately. On 24 August 1939 I find recorded in my notes as follows: 'Colony constantly raided since last day or two by house crows, in parties of 4 or 5, sometimes assisted by a couple of jungle crows. The crows hop from frond to frond of the palm, reaching out and pulling up the suspended nests till they can be held under foot, and tearing them to pieces with their bills in the region of the egg chamber. In one case a crow made a hole thus,  pulled out and gobbled up 3 naked young. It *apparently* left behind one or more, as the female baya flew up the entrance tube repeatedly afterwards, once with food in bill. One marauding crow was chivvied off a nest once or twice by a myna. All the time the colony is being raided, the bayas fly about innocuously and distractedly, settling on tree-tops at a distance and uttering an agitated *chit-chit-chit*. Now and again some of the bolder ones skim past the rifling crows, but without pressing the attack home. One crow clung to a nest, tore open the egg chamber and carried off what looked very like an adult cock baya, the yellow in whose plumage was conspicuous.'

This was the first time that I actually witnessed such raids, which, from the holes so often seen near the egg chamber of baya nests, must be of common occurrence elsewhere also. It must be added that these raids affected only a few nests at a time, and only those containing chicks, as far as could be made out. Thereafter, the crows passed on.

The point of particular interest was that after the first two or three days, the raids were not of daily occurrence but took place sporadically at intervals of several days each. On 19 September my note reads: 'Why are these raids so sporadic? After one or several successive raids in one day, there are no more until several days later'.

Indeed it seems odd that having discovered where easy booty was procurable, the crows should yet allow several days to go by before making their next onslaught. It all appeared diabolically calculated to give time for the unhatched eggs to become nestlings! No raids had occurred while the nests had contained only eggs. The nesting season was well advanced before the first raids began—at the time when most nests contained either hatchlings or hard set eggs. Certainly there is no question but that the raids took place at intervals of days, because the situation of the colony and the circumstances precluded the probability of my missing any of them. After the commotion in the colony created by the initial series of raids I was constantly on the alert for similar tumults, which heralded and accompanied every visitation by the crows and continued desultorily for a considerable time after it was 'All Clear'.

During these later stages of the nesting, and the period of raiding by the crows, a solitary shikra (*Astur badius*) was also observed to haunt the colony regularly. He usually spent long periods weaving his way through the bases of the fronds, deliberately searching for wobbly refugees from the ravaged nests. Another time the agitated *chit-chit-chit* of the birds revealed a Brown Tree Snake on the same quest gliding purposefully in and out of the frond stalks as the cocks fecklessly pranced and flitted about him.

33, Pali Hill, Bandra, SÁLIM ALI
Bombay 20,
*January* 15, 1956.

## 11. COLONIZATION OF ISLANDS BY WHITE-EYES (*ZOSTEROPS* SPP.)

On reading G. R. Williams's paper in the *Ibis* (Vol. 95, No. 4) on the 'Dispersal of Introduced Birds from New Zealand' I was struck by the fact that in almost every case in small and isolated islands one of the few land species occurring was a *Zosterops* sp. which had almost certainly colonised the island from the mainland of Australia or New Zealand by its own unaided agency, and not by human introduction. It will be recalled that when I visited the Laccadives in 1938[1] I found that the only two resident land birds were the white-eye and and the house crow. It seems a very remarkable coincidence that in such widely scattered parts of the world the genus *Zosterops* should have the faculty, above other passerines, of colonising desert islands and might be worth enquiring into.

It is difficult to see what particular attributes the white-eye possesses which enable it to establish itself on isolated islands. They are sedentary, non-migratory sylvicolous birds, little subject, one would imagine, to wind dispersal; and there are many other passerines which one would think would be far more likely colonists of oceanic islands.

There are the following points in their favour:

1. They tend to live in large flocks in the non-breeding season, and consequently if blown out to sea by a cyclone or some cataclysmic meteorological disturbance there is greater chance than in the case of almost any other small insectivorous bird of sufficient numbers landing together on an uninhabited island to start a breeding stock.

2. They are comparatively omnivorous, and where, as in the Laccadives, the coconut is found, can subsist on the nectar of the flowers and such small insects as visit it. Munias for instance, while living in large flocks would starve on the Laccadives.

3. They are sedentary and, in consequence, having arrived at an island where they can exist, are content to remain there. In the Laccadives they are found on Kiltan and Kadmat but not on Chitlat, 40 miles from Kiltan, nor on Amini 2 miles from Kadmat. In the

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[1] *vide JBNHS*, Vol. 40 pp. 382-387.

latter case, however, the fact that Amini has a population of house crows and Kadmat has none, may be the deciding factor.

ARDURA CRAIGNURE,
ISLE OF MULL, ARGYLL,
CRAIGNURE 21, SCOTLAND,
*October* 25, 1953.

F. N. BETTS

## 12. THE DUCK SEASON IN NORTH INDIA, 1955-56

I am sending you separately by parcel post the skin of a duck shot on X'mas day which I believe to be a female or immature male of the Bronzecapped Duck or 'Falcated Teal'[1]. It was obtained at a jheel about one mile north of Anta on the Hansi Branch of the Western Jumna Canal on the borders of the Karnal District, Punjab (I), and Jind District of Pepsu.

As regards my experience of duck this year [season 1955-56] in these parts, at first sight they would appear to be unexpectedly scarce. But on close investigation I have found that they are present in enormous numbers—perhaps in greater numbers than ever before seen in my 25 years experience of this locality. It seems to me, however, that they have noticeably changed their haunts and habits, in some cases leaving favourite jheels of former years quite unfrequented. I attribute this partly to over-shooting and harassment, partly to the enormous areas under water this year, and partly to the fact that the permanent jheels are all about 3 ft. deeper than usual. Thus surface feeders tend to favour temporary and shallow flood water which has the additional advantage of being unknown to most shikaris, since it is dry land in a normal year. Also persecution has made them leave, during daylight hours, permanent jheels which provide good feeding, but they flight in regularly in large numbers after dark, leaving again at first light. A good example of this is the famous Najafgarh-Gurgaon jheel about 20 miles from here, which is some 3 miles long this year. At the start of the season it was populated by duck and teal in almost unbelievable numbers, and a large number of Greylag Geese. As the shooting season progressed thousands of birds could be seen flighting in and out at dusk and first light, while thousands more learnt to seek safety in the middle and ignored the firing; thus one hears many unobservant shikaris saying that duck are scarcer than usual this year on their experience of this place alone. But during a 10 days X'mas camp 80 miles from here in the Karnal/Jind Districts, which is little known and inaccessible, we were scarcely ever out of sight of duck, even when partridge shooting, and were amazed at their abundance. Even here, however, they were restive and constantly on the move, and there was a noticeable flight every evening to feeding places evidently far distant.

As regards species of the migrants, Pintail have been seen in very large numbers, much more so than usual. All four pochard have also been seen in some abundance probably attracted by the large areas of deep water. Mallard, however, which have always been very local here, have for some reason been scarce even in their usual haunts. Of the residents, a very noticeable feature has been the large number of Spotbill seen this season, since formerly they were not common here; the numbers seen have been reminiscent of the south of India.

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[1] Identification confirmed.—EDS.

11, AURANGZEB ROAD,
NEW DELHI, O. H. DE ST. CROIX
*January* 9, 1956.

[It may be interesting to mention that Mr. N. A. Leslie of Karachi in a letter dated 17th December, 1955 wrote: 'As to your query about duck and snipe, I do not myself shoot, but my shooting friends say that snipe are about in unprecedently large numbers this year. As for duck, the complaint both here and in the Punjab is that there is so much water about after the floods that duck are hard to come by, scattered as they are over a far larger area. There seems to be no evidence that they are less plentiful than usual'.

Mr. H. C. Grieve of Calcutta in a letter dated 5th December also writes that duck are scarce but snipe plentiful.

Lt.-Col. E. G. Phythian-Adams in a letter dated 24th January 1956 writes: 'I was down in Mysore last week and found remarkably few snipe—not a quarter of what one expects to find at this season. Duck and teal too were very scarce. Can it be that most of the birds are still up north on the flooded areas? Or is it that as all our Mysore tanks are brim-full (at any rate in South Mysore) there is not the usual amount of duck-weed, etc.? I notice also that practically no migrant birds of prey are to be seen, either on the plateau or down below. Their absence is very noticeable'.—EDS.]

## 13. A LARGE INDIAN KITE, *MILVUS MIGRANS LINEATUS* (GRAY), WITH A SPLIT BILL[1].

(*With a text-figure*)

Of the large number of specimens of birds handled by me during the past several years in connexion with my studies, the most curious bill formation I have come across is in a specimen of the Large Indian Kite, *Milvus migrans lineatus* (Gray). The specimen is an adult female, collected at Chisapani Garhi, about 15 miles to the south-west of Kathmandu, Nepal, on the 26th July 1947, by Dr. Walter Koelz, and deposited in the American Museum of Natural History, New York. It possesses an additional process to its bill. This is a fixed, rounded, apparently solid structure with a rhamphotheca. It originates dorsally from the base of the upper mandible, and arches gently over the culmen, leaving a well-marked gap at its base. It tapers to a point a little short of the tip of the bill. The height of the bill at cere is smaller than that at its middle portion, but the length remains unaffected (fig. 1).

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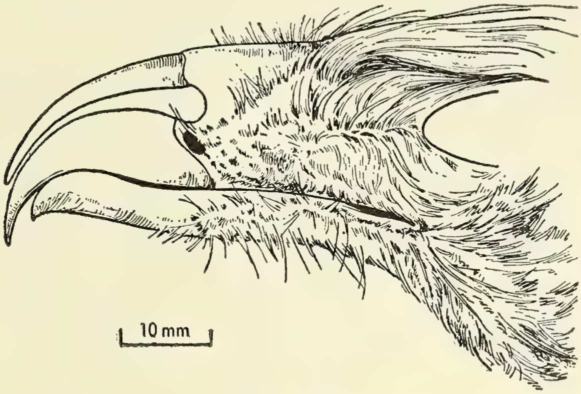
[1] Published by permission of the Director, Zoological Survey of India.



Lateral view of the head of a Large Indian Kite showing split bill.

To all intents and purposes it appears that the upper mandible has split up during the embryonic development of the kite, for which no reason can be assigned. This split-billed condition does not seem to have affected the normal life and activities of the specimen.

I am thankful to Dr. Walter Koelz and the American Museum of Natural History, New York, for allowing me to examine the specimen, and to Shri A. Karmakar for preparing the final sketch from my original drawing under my supervision.

ZOOLOGICAL SURVEY OF INDIA,
INDIAN MUSEUM,
CALCUTTA 13,
*December* 13, 1955.

BISWAMOY BISWAS

## 14. A NOTE ON NEWLY HATCHED CHICKS OF THE SLATYBREASTED RAIL, *RALLUS STRIATUS* LINNAEUS.

A pair of Slatybreasted Rail bred in the wader aviary of the Calcutta Zoo this year and four eggs were successfully hatched out. On the 30th July, one chick was hatched, and from the remaining three eggs three chicks came out on the 31st. While the first chick died in the nesting basket on the 31st, the three others descended to the ground along with the mother on the 1st August.

A search through the available literature for any record on the newly hatched chicks of the Slatybreasted Rail, proved abortive. Coward in his 'Birds and their Young' (1923, p. 57), however, says, whatever the plumage of the adult rails the young in their down dress are self-coloured, blackish grey or sooty.' I, therefore, give my observations below.

*Chick in down.*—Thickset woolly down black all over. Bill, legs, feet and claws black. The bill is proportionately a very small and bluntly conical structure, very different from that of the adult. It is, however, laterally compressed. The first-born chick has a minute, white egg-tooth. A trace of the egg-tooth is also present in one of the specimens born later.

Measurements in millimeters :

| — | A | B | C | D |
|---|---|---|---|---|
| Tip of bill to root of tail along curvature of dorsal side ... | 81 | 84 | 90 | 82 |
| Bill from anterior edge of nares ... | 3·5 | 4·5 | 4·1 | 3·5 |
| Depth ot bill at nostril ... | 4·5 | — | 4·4 | — |
| Width of bill at nostril ... | 2·3 | 2·0 | 2·5 | 2·1 |
| Tarsus ... | 12·3 | 12·5 | 13·0 | 13·0 |
| Longest toe (middle) without claw ... | 14·5 | 17·5 | 18·5 | 14·5 |
| Egg-tooth ... | Present | Absent | Absent | A trace present |

The chicks were apparently healthy and were seen being assisted by the mother in feeding. The hen picks up minute particles of food (ants' eggs, shrimps etc. supplied for rearing wader chicks) places before the chicks, and draws their attention to the food particles by pecking about it.

When Painted Spurfowl, Indian Water-Rail, Spotted Crake etc., which share the same aviary, attempted to come near the chicks they were promptly driven away by the mother.

Unfortunately the three chicks suddenly died on the 3rd August.

Zoological Gardens, Alipore,
Calcutta 27, R. K. LAHIRI
*December* 1, 1955.

## 15. HAWK DROWNING WOUNDED DUCK

Last Sunday I witnessed a remarkable incident.

We were shooting at Gondal Tank and were attempting to despatch a wounded teal on the water some 100 yards away with a .22 rifle. After one or two shots it was hit but not killed and flew a short way to be stooped upon by some kind of eagle or buzzard.

The identification of birds of prey is not my forte but this was a blackish brown bird, of heavy flight and slightly larger than the common kite. Its cheeks and the sides of its neck appeared to be yellow.

As what I shall now call the buzzard stooped, the teal dived. When the latter rose again to the surface the process was repeated and so on for four or five times. Then the buzzard, apparently tiring of this game, stooped once more and sat on the water over the teal, appearing to hold the bird under water to drown it. He remained in this position for three or four minutes until he was moved by a shot into the water near him. The teal at once rose to the surface and a few moments afterwards the buzzard returned, stooped, and resumed his position on the water. This time the buzzard stayed there longer and as we could not wait he was once again moved by a shot and this time went right away. A minute or two later the teal floated to the surface and apparently expired almost immediately.

At the place where this incident occurred the water was certainly more than 6 ft. deep and there was a very thin growth of weeds trailing on the surface of the water, but not enough I am sure to support the buzzard.

I witnessed this scene through binoculars.

RAJKUMAR COLLEGE,
RAJKOT, M. A. WYNTER-BLYTH
*February* 1, 1956.

[Reference is invited to the Gleaning 'Swan Song' and the editorial note to it (Vol. 52, p. 655) dealing with this subject.—EDS.]

## 16. A JUMPING SNAKE

Dr. Maurice Burton in the *Illustrated London News* of 12th November, 1955 discusses an incident of a five-foot long snake progressing down a mountain side in Liguria in a series of jumps. This reminds me of a jumping snake which I saw in Balasore (Orissa) in 1926. I was motoring along the main road when I saw about 25 to 30 yards in front of me a light-brown coloured, five-foot long snake crossing the road. I accelerated with the intention of running over it. The snake saw me approaching and began to move faster but could not move fast enough to escape. When I was about 2 yards from it and made certain that I must crush it, it rose into the air and got away from me. The angle at which it rose was about 45° or a little more. It reached a height of 3 to 4 ft., but its tail was never very far from the ground. I stopped the car and tried to find the snake, but it disappeared among the bushes and so I was unable to identify it.

It would be interesting to know whether any of your readers have had experiences of jumping snakes.

16, UNION PARK,
KHAR, BOMBAY, 21, D. E. REUBEN
*January* 24, 1956.

## 17. A NOTE ON FISHES OF THE FAMILIES SYNGNATHIDAE AND PEGASIDAE AND THE ORDER HETEROSOMATA IN THE COLOMBO MUSEUM

In the course of my studies of the fishes in the collections of the Colombo Museum I discovered the presence of three species among the

Syngnathidae and four species among the Heterosomata not hitherto recorded off Ceylon. These are:

| Name | No. of specimens in the collection | Locality |
|---|---|---|
| *Syngnathus cyanospilus* Bleeker ... | 4 | Pearl banks and off Jaffna. |
| *Hippocampus hystrix* Kaup ... | 1 | Pearl banks. |
| *Hippocampus trimaculatus* Leach ... | 4 | Pearl banks. |
| *Pseudorhombus dupliciocellatus* Regan ... | 2 | Pearl banks. |
| *Pseudorhombus elevatus* Ogilby ... | 13 | Pearl banks and off Panadura. |
| *Pardachirus marmoratus* (Lacépède) ... | 2 | Pearl banks. |
| *Brachlrus albomaculatus* (Kaup) ... | 1 | Off Negombo. |

Amongst these first records the record of *Pseudorhombus dupliciocellatus* and *Hippocampus trimaculatus* off Ceylon indicates a westward extension of the range of distribution of these species, whilst the record of *Pardachirus marmoratus* off Ceylon indicates an eastward extension of its range of distribution.

The Colombo Museum also possesses a single specimen of *Pegasus volitans* Linné collected from China Bay, Trincomalee. This is the second record of this species for the Indian Ocean, the first being that of Johnstone (1904, Pearl Oyster Reports, pt. 2, p. 214) from off Aripu.

NATIONAL MUSEUMS,
CEYLON,
*September 7, 1955.*

P. H. D. H. De SILVA,
*Assistant in Zoology.*

## 18. FOOD OF THE WHALE SHARK, *RHINEODON TYPUS* (SMITH): EVIDENCE OF A JĀTAKA SCULPTURE, 2ND CENTURY B.C.

(*With a plate*)

It is not my intention to enter into a controversy raised in McCann's recent article[1], in which he has tried to prove that the Whale Shark is a vegetarian fish, browsing on long filamentous marine algae, as against Gudger's statement[2] to the following effects:

> 'However, *Rhineodon* must need and must get bulkier food. This it undoubtedly finds in sardines and like small surface-feeding fishes,

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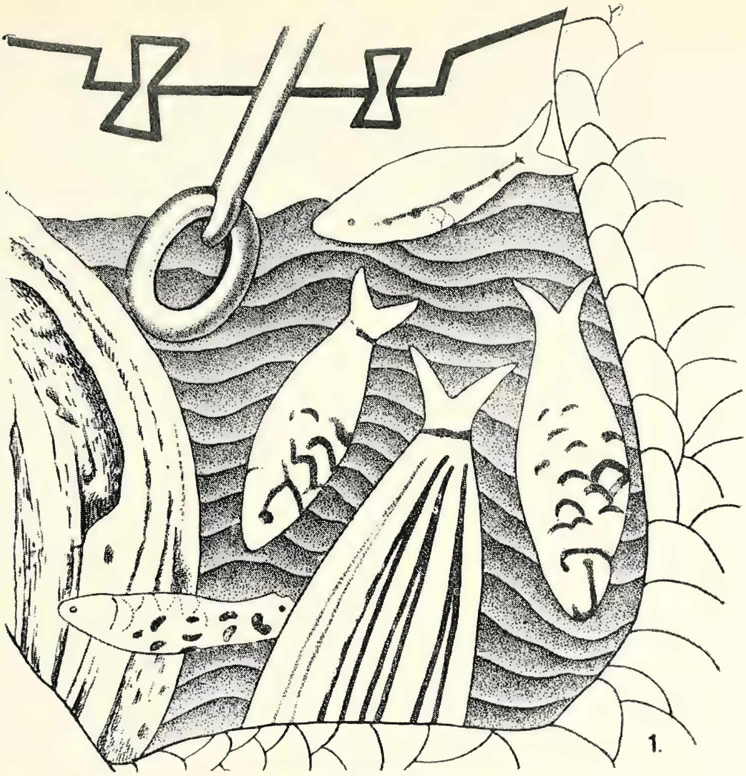
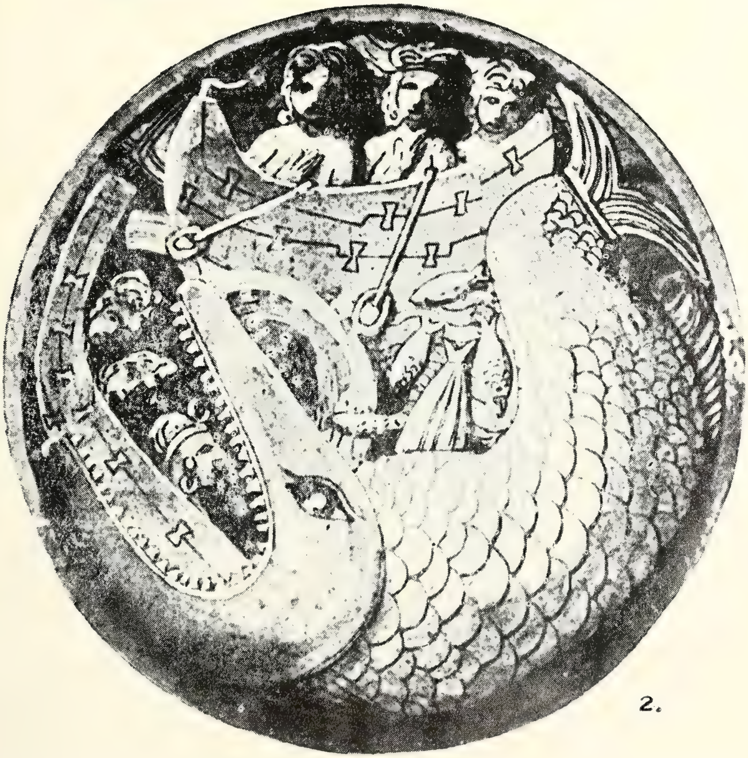
[1] McCann, C. The Whale Shark, *Rhineodon typus* (Smith). *JBNHS*, **52**: pp. 326-333 (1954).

[2] Gudger, E. W. What ultimately terminates the life span of the Whale Shark, *Rhineodon typus? ibid.*, **51**: pp. 879-884 (1953).



1.



2.

*Timingila Jātaka* Medallion (2nd century B.C.) depicting 'Whale Shark'

and their feeding and schooling habits make it easier for the Whale Shark to get them in great quantities. Like *Rhineodon,* they are plankton-feeders on the surface and go in schools. The sardine fishermen off Lower California often find *Rhineodon* competing with them—indeed, they sometimes get a Whale Shark in their sardine nets. These sardines are presumably the largest fish on which *Rhineodon* normally feeds. However, it probably sometimes feeds on any somewhat larger fishes that it gathers at the surface and can swallow through its small gullet. And it is also known that it feeds on small squids.'

Quite recently, in my article[1] on 'Fish in Jātaka Sculptures' in commenting (page 10) on the *Timiṅgila Jātaka* Medallion among the Bharhut reliefs of the 2nd century B.C. (Plate, fig. 2) it was pointed out that *Timiṅgila* does not refer to a true whale but to the Whale Shark, and that its food-fishes, such as mullets, sardines and small perches, are shown in the medallion (Plate, fig. 2). When the fish inhales water for oxygenating its gills, the power of suction is so great that a small boat with three occupants could be sucked into its cave-like mouth as is so clearly shown in the medallion. It is evident, therefore, that even sizeable fish and other animals, besides plankton and small shoaling fishes, could form the food of the Whale Shark.

It is not surprising that McCann found the intestines of the young specimens of *Rhineodon* full of algae, for fishery biologists know that the feeding habits of the young invariably differ from those of the adult, and that the same may be different in different seasons according to the availability of the nature of food at the time. The actual records of the feeding habits of this monster fish are so meagre that it is quite likely that both McCann and Gudger may prove to be correct according to size of the specimen and seasons of capture of the fish.

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA 12,
*October* 14, 1955.

SUNDER LAL HORA

## 19. ADDITIONS TO THE APHID FAUNA OF INDIA

In his previous papers (David 1954 a & b), the writer had furnished notes on 64 species of aphids which had been noted by him in South India. Since then further records of aphids have been obtained in this area. In this note six species which are new to this country are reviewed. Of these except the first, the other five are met with only in the high hill ranges of the Nilgiris up to about 7,200 ft. above mean sea level.

### 1. **Aulacorthum (Neomyzus) dispersum** (v. d. Goot)

This species is easily distinguished by its colour. The larvae are yellow with a purple patch around the siphunculi; the legs, siphunculi

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[1] Hora, S. L. Fish in Jātka Sculptures, *Journ. As. Soc.* Science, XXI, pp. 1-13 (1955).

and cauda are pale with the antennae dark. The apterae are dark greyish green with the cauda and the base of the third antennal segment pale. Eyes dark brown; legs dark in the distal half of femora and the ends of tibiae. In macerated specimens the dorsum has dark patches on each segment up to the second abdominal segment and the sixth and seventh segments. Alatae are dark greenish black with dark siphunculi and a pale cauda having 3 or 4 hairs.

Measurements in mm.

| | Length of body | Antennae | Siph. | Cauda | Antennal segments | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | III | IV | V | VI |
| Apterae | ... 2·08 | 2·47 | ·54 | ·28 | ·60 | ·45 | ·37 | (·11+·77) |
| Alatae | ... 1·53 | 2·45 | ·48 | ·22 | ·55 | ·42 | 37 | ( 12+·82) |

Rhinaria in apterae III-16, IV-17, V-10 and in alatae III-34, IV-20, and V-11. Last segment of rostrum ·16, Second joint of hind tarsus ·15.

Host-plant and locality: *Emilia sanchifolia* in Coimbatore during January 1954.

*Notes.*—The aphids feed usually on the undersurface of leaves and are met with in considerable numbers. There is no perceptible effect on the plant due to their feeding. Ants do not visit them.

This species has so far been recorded only in Java. Although it is very near *Neomyzus* van der Goot, this subgenus differs from it by the presence of rhinaria on the V antennal segment, also in both apterae and alatae. It is however retained in this subgenus for the present.

2. **Capitophorus eleagni** (Del Guercio)

This aphid conforms in general characters to the typical European form but differs in having the hairs on the vertex longer, about twice the basal breadth of the III antennal segment. The hairs on the VII and VIII abdominal segments are even longer. The colour of the living form is invariably yellow with paired transverse green bands across the abdominal segments, of which those on the II abdominal segment are longer.

Measurements in mm.

| | Length of body | Ant. | Siph. | Cauda | Antennal segments | | | | Rhinaria | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | III | IV | V | VI | III | IV | V |
| Apterae | ... 1·96 | 1·92 | ·60 | ·22 | ·39 | ·34 | ·28 | (·09+·69) | | | |
| Alatae | ... 2·02 | 2·25 | ·48 | ·13 | ·54 | ·41 | ·29 | (·11+·77) | 47 | 29 | 7 |

Last segment of rostrum .15 and second joint of hind tarsus .09

Host-plant and locality: *Cynara scolymus* in Ootacamund during January and July.

*Notes.*—The aphid occurs in very large colonies on the undersurface of the leaves of this plant and sometimes covers the entire leaf. It is difficult to distinguish the presence of the aphid due to its cryptic coloration. Ants are not found attending on it and the only indication of its presence is given by the development of sooty mould on the honeydew. The drain of sap from the plant due to the feeding of considerable numbers of this aphid noticeably retards the growth of the plant.

It is learnt from Dr. D. Hille Ris Lambers that a certain amount of variation in the structure of the hairs exists in forms collected from Eritrea. Therefore the South Indian form is retained in this species.

3. **Eutrichosiphum lithocarpi** Maki.

The larvae of this aphid are reddish and the apterae and alatae dull black. Siphunculi small and dark with long stout hairs. Hairs on the vertex and the two spinal ones on the VIII abdominal segment, about 4 times the basal breadth of the III antennal segment. Hairs on the antennae are about 1/3 the former. Last rostral segment long, narrow and tapering, about 5 times the length of the second joint of the hind tarsus. The whole body is covered with closely arranged nodules. Tibia have 4 spurs and the tarsal formula is 7, 7, 7. Alatae have dark sclerotic pattern extending like a patch on the venter of the abdominal segments.

Measurements in mm

| | Length of body | Ant. | Siph. | Antennal segments | | | | | | Rhinaria | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | I | II | III | IV | V | VI | III | IV |
| Apterae ... | 1·72 | ·61 | ·31 | ·06 | ·04 | ·15 | ·08 | ·09 | (·11+·18) | | |
| Alatae ... | 2·19 | 1·33 | ·65 | ·06 | ·06 | ·47 | ·17 | ·17 | (·14+·26) | 18 | 4 |

Length of last segment of rostrum .34 and second joint of hind tarsus .09.

Host-plant and locality. *Quercus montana, Q. coccinea,* and *Q. serrata* in Ootacamund in January.

*Notes.*—The aphids are found on the undersurface of leaves or in leaf axils in the terminal portions of branches. Only about 4 or 5 are found on a leaf but they are spread out on a number of leaves. Ants have no attraction for them.

4. **Macrosiphum hellebori** Theobald and Watson (?)

This is a large green aphid which resembles *Macrosiphum euphorbiae* (Thomas) closely. The number of hairs in the cauda are usually more than 11 and the legs have the distal portions of femora dark.

Measurements in mm.

| | Length of body | Ant. | Siph. | Cauda | Antennal segments | | | | Rhinaria |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | III | IV | V | VI | III |
| Apterae ... | 2·99 | 3·91 | ·97 | ·44 | ·92 | ·75 | ·70 | (·18+1·14) | 3 |

Length of the last rostral segment .14 and the second joint of the hind tarsus .15.

Host-plant and locality: *Ranunculus* sp. in Ootacamund in September.

*Notes.*—The aphid feeds on the stem in large numbers. The plant is not affected in any way by their feeding.

This species was listed as a synonyn of *M. euphorbiae* (Thomas) by Lambers (1947). However, he states that it has to be a separate species for the characters mentioned above.

5. **Myzus (?) hemerocallis** Takahashi.

Apterae yellow with pale cylindrical siphunculi and wide flange. The antennae are short and dark. Head with minute spinules all over. Cauda conical. Alatae do not have the sclerotic patch on the abdominal tergites.

Measurements in mm.

| | Length of body | Ant. | Siph. | Cauda | Antennal segments | | | | Rhinaria |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | III | IV | V | VI | III |
| Apterae ... | 1·76 | ·90 | ·35 | ·13 | ·22 | ·12 | ·12 | ·07+·27 | |
| Alatae ... | 1·80 | 1·30 | ·29 | ·15 | ·42 | ·22 | ·16 | ·09+·40 | 6 |

Length of the last rostral segment .10 and second joint of the hind tarsus .10.

Host-plant and locality: *Hemerocallis flava* in Ootacamund and Coonoor (6,000 ft.). Also *Agapanthus umbellatus* at Coonoor. The aphid is found in January.

*Notes.*—The aphids are found usually in between the two tender central leaves and are not visited by ants. No mark of injury is seen on the plant even when large numbers are present. Only the alates are seen on the tips of the leaves.

This aphid has so far been noted only in Formosa. Though it does not possess the sclerotic pattern on the abdomen in alates, which is typical of the genus, it has much affinity with this genus.

6. **Myzus ornatus** Laing.

Apterae are pale yellowish all over with pale, cylindrical, tapering siphunculi and a large flange. Cauda broad and constricted at the base. Dark intersegmental spots are found pleurally on the thorax and abdomen.

Measurements in mm.

| | Length of body | Ant. | Siph. | Cauda. | Antennal segments | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | III | IV | V | VI |
| Apterae ... | 1·63 | ·89 | ·32 | ·14 | ·25 | ·15 | ·11 | ·09+·18 |

Length of the last rostral segment .09 and second joint of the hind tarsus .09.

Host-plant and locality: *Cineraria* sp. in Ootacamund during January.

*Notes.*—The flower stalks are usually infested by hordes of these aphids which either stunt the growth of the plant or distort the formation of flowers.

### ACKNOWLEDGMENTS

My grateful thanks are due to Dr. D. Hille Ris Lambers, Holland, for his kind help in identifying the aphids.

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S. KANAKARAJ DAVID

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## 20. SOME INSECTS ATTRACTED TO LIGHT—III

The following insect species were taken at light in addition to those already reported by me (*JBNHS*, **52**: 647-650 and 950-951). The collections were made in Bangalore during March-May 1955, unless otherwise indicated. I am most grateful to the authorities of the Commonwealth Institute of Entomology, British Museum (Natural

History), London, for the determination of the species included here. I am likewise grateful to Dr. M. Putta Rudraiah, Government Entomologist, for facilities.

## LIST OF INSECTS

### EPHEMEROPTERA

Baetidae.—*Cleon* sp. ♀ (Novr. '53).

### HEMIPTERA

Lygaeidae.—*Dieuches leucoceras* Walker, *Nysius melanicus* Distant and *N. minor* Distant.

Jassidae.—*Deltocephalus* sp.

### LEPIDOPTERA

Gelechiidae.—? *Brachmia* sp. (Novr. '53), ? *Chelaria* sp., *Lecithocera* sp. and ? *Telphusa* sp.

Cosmopterygidae.—*Cosmopteryx albilineela* Dev. and *Cosmopteryx* sp. (Novr. '53).

Hyponomeutidae.—*Plutella maculipennis* Curt.

Tineidae.—*Tinea opsigona* Mey. (Novr. '53), *Trichophaga monachella* Hb. (Novr. '53), and *T. trimaculella* Snell. (Novr. '53).

Olethreutidae.—*Argyroploce* sp., *Crocidosema plebeiana* Zell. (Novr. '53) and *Psorosticha zizyphi* St. (Novr. '53).

Pyralidae.—*Charltona* sp., *Crambus* sp. (Novr. 53), *Loxostege messalis* Walk., *Nymphula affinialis* Guen., *Phycita* (s.l.) sp., *Udea brevialis* Walk.

Lycaenidae.—*Talicada nyseus* Guer.

Lymantridae.—*Lymantria fuliginosa* Moore.

Arctiidae.—*Asura* sp.

Agrotidae.—*Eustrota opella* Swinh. and *Hydrillodes lentalis* Guen.

Xyloryctidae.—*Odites* sp. (Novr. '53).

### COLEOPTERA

Carabidae.—*Clivina memnonia* Dej. and *Macrochilus* 3-*maculatus* Oliv.

Elateridae.—*Agrypnus fuscipes* F. and *Ludius* sp. nr. *hirtellus* Cand.

Tenebrionidae.—*Microcrypticus* sp.

Copridae.—*Onthophagus* sp., nr. *orissanus* Arrow.

Aphodiidae.—*Aphodius costatulus* Schmidt and *A. parvulus* Har.

Melolonthidae.—*Apogonia villosella* Blanch.

Rutelidae.—*Adoretus bicolor* Brenske.

### HYMENOPTERA

Braconidae.—*Apanteles* sp.

Formicidae.—*Aenictus* sp., *Camponotus* spp. (more than 3 species seem to be involved), *Myrmecaria* sp. and *Polyrhachis* sp.

### DIPTERA

Muscidae.—*Atherigona* sp. ♀.

DIVISION OF ENTOMOLOGY,
DEPARTMENT OF AGRICULTURE,
BANGALORE,
*December* 31, 1955.

S. USMAN

## 21. NOTE ON THE LIFE-HISTORY OF *LEMA SEMIREGULARIS* JAC. (COLEOPTERA, CHRYSOMELOIDEA, CRIOCERIDAE)

Eighty-one species of *Lema* are known to occur in India (Jacoby, 1908; Lefroy, 1909). Lefroy (1909) opined that although these beetles were common on grass and on plants in the plains, life-history of none was definitely known and this statement holds true to date. Recently Sengupta (1952) and the authors (Sengupta and Behura, 1953, 1955) studied the life-history of *Lema praeusta* Fab. and *L. signatipennis* Jac. respectively and recorded them, and *L. semiregularis* Jac. on turmeric (*Curcuma longa*) for the first time. The only other species of *Lema* known to occur on turmeric is *L. fulvicornis* Jac., in Ceylon (Huston, 1937).

*L. semiregularis* was first noticed as a minor pest on turmeric in 1949 in the district of Phulbani (Orissa) along with *L. praeusta* and *L. signatipennis*. During subsequent years all the three species appeared in major pest form in Phulbani, and are so far known to be confined to that district. Adult specimens of *L. semiregularis* were obtained from the Turmeric Research Station, G. Udaygiri, and reared at Cuttack in the Entomological Laboratory of the Department of Agriculture, Orissa, at ordinary room temperature in glass jars covered with muslin during November 1953 to January 1954. Besides, field observations were also made by the staff of the Entomological Section of the Agriculture Department stationed at G. Udaygiri and Phulbani.

It is interesting to note that the different stages in the life-history of the three species of *Lema* infesting turmeric in Orissa, viz., *L. praeusta*, *L. signatipennis* and *L. semiregularis* were extraordinarily similar.

### LIFE-HISTORY

Egg: The eggs are laid singly on the leaves, being thrust into the tissues. No female was observed to lay more than 11 eggs within 24 hours, counts of 3, 5, 8, 9, 10 and 11 being typical for the egg masses. Incubation lasted from 4 to 5 days.

Larva: The larva on emergence measured about 0.13 mm. in length. Locomotion and feeding in the larva was noticed immediately after emergence. The apex of the anal segment is turned upwards and the faeces are released little by little so that they covered the dorsal part of the abdomen of the larva. The excreta are green and initially very little in quantity, appearing as a speck on the abdomen. Gradually they become heaped so as to form a protective covering for the larva. During the course of its development the old faecal matter on the abdomen gets discarded automatically and is left on the leaves and fresh excreta are again deposited. The larva is a voracious feeder. It grew to a length of about 0.54 mm., after which it pupated. The larval period lasted about 15 days.

Pupa: Before pupation the protective covering of faeces is discarded and feeding is slow. The head of the pupa is pale brown and the abdomen is very much enlarged and yellowish in colour. White streaks of 2-3 mm. long appear all over the abdomen. The pupa measured about 1.0 × 0.8 mm. and 1.2 × 0.8 mm. The pupal stage lasted about 19 days, giving rise to the blue (elytra) adult.

The total number of days from egg to adult lasted about 39 days.

Grateful thanks are due to the Director, Commonwealth Institute of Entomology, London, for the determination of the insect species.

AGRICULTURAL RESEARCH STATION, G. C. SENGUPTA
BHUBANESWAR. *State Entomologist.*

DEPARTMENT OF ZOOLOGY, B. K. BEHURA.
RAVENSHAW COLLEGE,
CUTTACK.
*November 2, 1955.*

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Sengupta, G. C. and Behura, B. K. (1953): Observations on the life-history of *Lema signatipennis* Jac. (Chrysomelidae) as a pest of Turmeric (*Curcuma longa*). *Proc.* 40 *Ind. Sc. Cong.* (3): 198.

Sengupta, G. C. and Behura, B. K. (1955): Some new records of crop pests from India. *Indian J. Ent.* **17**: 283-285.

## 22. BEHAVIOUR OF BUTTERFLIES BEFORE OVIPOSITION

Recently, while going through the excellent series of articles published in your journal by the late Mr. T. R. Bell on 'Common Butterflies of the Plains of India', I came across a paragraph [p. 679, Vol. 19 (3), 1909] containing what is most probably the first description of the interesting phenomenon which I have called the 'Drumming' of the female butterfly prior to oviposition. I myself have described this reaction for some European butterflies (*Aglais urticae*, *Argynnis paphia*, *Pieris brassicae* and *Aporia crataegi*; the Swallowtails *Papilio machaon* and *podalirius*, and also for one cosmopolitan species common in India, i.e., *Vanessa cardui*, the Painted Lady (see Sitzber. der naturf. Freunde, Berlin, 1934, Sitzber. der dtsch. entomol. Ges. 7, 1937, and *Nature* 140, 1937), and have also taken some cinematographic records of 'drumming' in *urticae*, *paphia* and *cardui*. Up till now, I had only found one footnote in the literature concerning this, by the late Prof. W. T. M. Forbes in Comstock's 'Introduction to Entomology', 1924, p. 750, who mentioned the 'drumming' in some American Satirid[1], and that only after my own description had been published. But obviously the credit for the discovery of the reaction must go to Bell, who wrote as early as 1909 with regard to *Euthalia garuda* More, thus:

'The female of this species when engaged in laying eggs may be seen, if carefully watched, or *heard* hammering the leaf-surfaces with the *imperfect frontlegs*[2] before depositing an egg; *E. lepida* has also been seen to do this.'

He further mentions that the food plants for the larvae of these two species are mango and cashew-nut tree, and 'Flame of the Forest' respectively.

I have been fortunate insofar as I was in charge of large observation cages where conditions could be more or less controlled; in this way, I have been able to watch the 'drumming' of female nymphalids in detail which, having been brought up in the cage, had lost their usual shyness. In these the 'drumming'—a quick alternating tapping on the surface of the leaf—is performed, as in *Euthalia*, with the *reduced* pair of frontlegs, thrown out only for that occasion and therefore easily distinguished. In Pierids and Papilionids, on the other hand, where the 'drumming' is performed with normal frontlegs, it was often possible to identify the reaction, not by sight, but by sound alone. I have also seen a few female butterflies in the process of 'drumming' in India, but unfortunately, have not got the records with me here. It would be interesting to hear whether other readers have observed this phenomenon, which should be easy in a country with such a great wealth of butterflies breeding almost throughout the year.

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[1] According to a written communication by Dr. Forbes, the species was *Basilarchia astyanax*, ovipositing on *Tilia* at Westborough, Mass., which was *heard, then seen tapping* with the forelegs alternately on the leaf.

[2] The italics are mine. D. I.

Bell (ibid.) then proceeds to give his interpretation of this peculiar behaviour as follows:

'The reason . . . may be to frighten micro-ichneumons or spiders off the leaf . . .'

Interesting though this suggestion may be, it seems to me that some of my further observations do not support this idea; quite apart from the fact that evidently such an effect as postulated by Bell, could only be very temporary, and that nothing would prevent the parasite or predator from returning to the same leaf within a few seconds, in order to attack the newly laid eggs.

I should like to suggest that sufficient evidence has now been accumulated in favour of my interpretation that the 'drumming' serves to test the physical as well as the chemical properties of the leaf surface, and particularly by the latter means, probably to identify the species of the plant. In fact, some such device appears necessary, unless we assume that the female butterfly selecting the food plant of the larva, sometimes without ever having seen it before, is an experienced botanist!

1. Testing of physical properties:

Though I myself have not noticed that after 'drumming' the butterfly selects a leaf of a certain consistency, it is quite imaginable that this reaction helps her, e.g., to assess the degree of turgidity of the leaf in question. The remark by M. Hering (in his 'Biologie der Schmetterlinge', 1926), that female butterflies usually prefer those leaves for laying their eggs which are neither too juicy nor too dried up, seems to point in this direction.

2. Testing of chemical properties:

Here we seem to be on safer ground. In my observation cages (built for the purpose in Germany as well as in England and in Poona), time and again I have been able to follow a female butterfly with my eyes on her 'trial flight' from leaf to leaf, during which she kept drumming on a number of individual leaves belonging to various plants, only to take off again immediately after each 'performance'. This was continued for a long time, until at last, sometimes apparently by chance, she reached one of the food plants of her larvae; only then was the 'drumming' followed immediately by oviposition. The female of the Cabbage White, *Pieris brassicae*, even used to 'drum' on any green or bluish-green surface, be it a watering-can, a dress or a piece of paper, as well as on all kinds of leaves; but only after she had reached a cabbage leaf, or a leaf of some other crucifer, would the 'drumming' be followed by her settling down to oviposition. If the food plant happened to have been removed from the cage altogether, then the female would occasionally lay some eggs on the 'wrong' plant, e.g., *Papilio machaon* or even, in rare cases, on green paper (unpublished observation by U. G. Vaidya with a female of the Indian *Papilio demoleus* in our observation cage in Poona). Perhaps most convincing of all is the observation that the female of the European Silver-washed Fritillary, *Argynnis paphia*, after having 'drummed' extensively on the food plant of her larva—a forest violet—nevertheless will not deposit her eggs on that plant at all; instead, she will immediately fly to the nearest tree trunk and oviposit on it, inserting the tip of her abdomen into the crevices of the bark. Since no 'drumming' has ever been observed to occur at this actual place of oviposition, Bell's explanation cannot be applied to this case. (In the meantime, my own observation, undertaken in a cage, has been fully confirmed in the open by Dietrich Magnus in Tübinger.) Incidentally, the biological effect of this involved instinctive response is beautifully clear; through it, the female avoids laying her eggs on the summer leaves of the violet, which would not provide sufficient protection for the caterpillar hatching in autumn, against the vicissitudes of a European winter; instead, she lays them in the bark where they can hide, but only of such trees as are close enough to the violet to allow the hungry caterpillars to find their way to the food quickly in the following spring. I wonder whether a comparable instinct may exist in some Indian fritillary or other butterflies whose caterpillars may have to undergo a resting period?

POONA, DORA ILSE
*December* 27, 1955.

### LITERATURE

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## 23. TERMITES FROM NEAR BAGHDAD, IRAQ

During the Field Museum Expedition to the Near East, 1936, I collected some termites from near Baghdad. Determination by Professor Alfred Emerson of the University of Chicago identifies them as *Microcerotermes diversus* Silvestri, a species described in 1920 from Amara on the lower reaches of the Tigris.

Emerson writes: 'As far as I know, the species has not been reported from any other locality since that time. I had cotype winged specimens in my collection, but no soldiers. I had a soldier from Jerusalem determined by R. G. Temple of the British Museum as this species, but careful comparison proves the Jerusalem specimens to be a new species. The specimens you collected agree perfectly with the original description and drawings.'

COCONUT GROVE,
FLORIDA, HENRY FIELD
*November* 2, 1955.

## 24. SHEEP AS A NEW HOST OF THE TICK, *DERMACENTOR AURATUS* SUPINO (FAMILY IXODIDAE)[1]

A collection of ticks made from sheep and sent to the Zoological Survey of India by Sri R. D. Katiyar, Assistant Disease Investigation Officer (Sheep & Goat), Animal Husbandry Department, U.P., Lucknow, has been identified as follows:

1. *Boophilus australis* (Fuller)
2. *Rhipicephalus haemaphysaloides* Supino
3. *Haemaphysalis bispinosa* Neumann
4. *Dermacentor auratus* Supino

The first three species are well-known for their occurrence on sheep and goat, while the last, *Dermacentor auratus* Supino, comprising a male and a female specimen collected from sheep at the Central Sheep and Wool Research Station, Pashulok-Rishikesh, Dehra Dun District (U.P.), in July 1954 is interesting in as much as it is recorded here for the first time from sheep.

Sharif (1928) commented on the taxonomy, distribution and hosts of *D. auratus*, and Sen (1938) has given an exhaustive list of hosts of this widely distributed Oriental species. In neither of the abovementioned works nor in later literature is there any reference to sheep or goat as a host of *D. auratus*.

*D. auratus* is a well-known pest of wild animals and has been so far recorded from Borneo (off *Potamochoerus larvatus* F. Cuv.); Java (off *Sus vittatus* Temm.); Sumatra (off wild pig); Carin-chela and Mooleyet in Burma (off *Ursus torquatus* Wagn. and *Sus cristatus* Wagn.); Ceylon (off bear) and Nias (off pig). In India it is recorded from Nagabera, Goalpara District, Assam (off wild boar); Naihati, Bengal (off deer); Calcutta (off man); Singhbhum District, Bihar (off wild pig); Chandan Chowki (off *Felis pardus* Linn.) and Bhowali (found on the clothing of a man on his return from the jungle) both in the Naini Tal District, Uttar Pradesh; Songra in the Gonda District (off *Melursus ursinus*); Helvak, Koyna Valley (host unknown) and Nechal, Western Ghats (host unknown), both in the Satara District, Bombay State.

Its accidental transport or attachment from one host to another or even to the clothes of human beings traversing grazing land of wild animals is not unknown as will be evident from the distribution of the species and its hosts given above. However, in the present instance, as the specimens were collected from a controlled stock of sheep and as one of the specimens (female, length 9.5 mm. and width 7.8 mm.) was gorged with blood, we are led to think that it is also equally capable of sustaining itself on sheep.

Kouwenaar and Wolf (1934) were able to produce rickettsiosis experimentally in guinea-pig in Sumatra by inoculating suspensions of crushed examples of *Dermacentor auratus* Supino and *Rhipicephalus haemaphysaloides* Supino, collected from wild pigs. Sharif (1938) has identified on numerous occasions nymphs of *D. auratus* collected from man at the School of Tropical Medicine and Hygiene, Calcutta, and he suspects that *D. auratus* is the real vector of the tick-typhus fever in India and that *R. haemaphysaloides* may play some part in the transmission of the disease.

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[1] Published with the permission of the Director, Zoological Survey of India.

The author is deeply grateful to Dr. A. P. Kapur for his instruction and help in this piece of work.

ENTOMOLOGICAL ASSISTANT,
ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA,
*October 27, 1955.*

G. MATHAI

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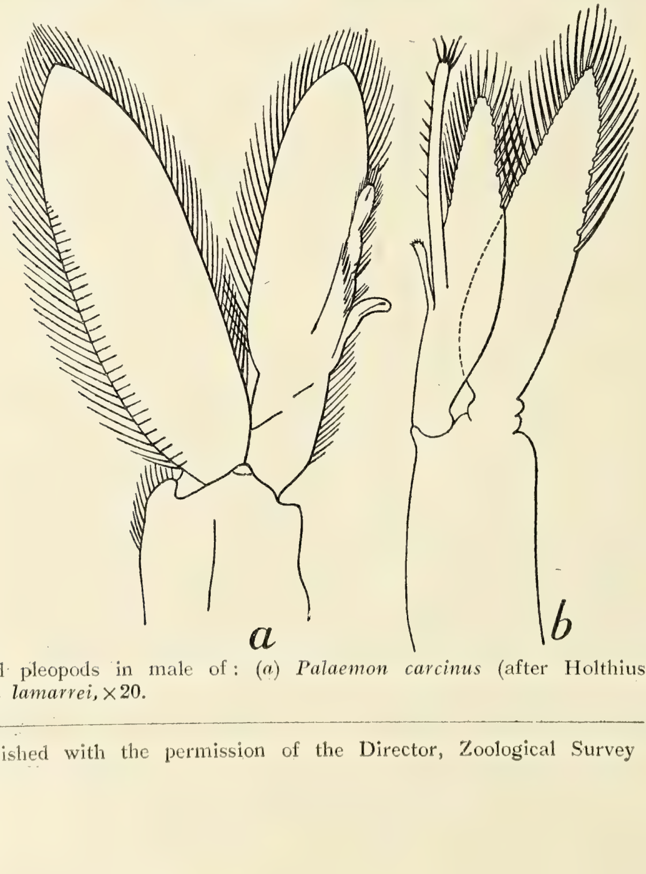
Kouwenaar, W. and Wolf, J. W. (1934) : *Geneesk. Tijdschr. Ned. Ind.* **74** : 1659.

## 25. APPENDIX MASCULINA OF *PALAEMON LAMARREI* H. MILNE-EDWARDS[1]

(*With a text-figure*)

In all the known species of *Palaemon* Fabr. (=*Macrobrachium* Bate) the males are distinguished from females, in addition to other



Second pleopods in male of: (*a*) *Palaemon carcinus* (after Holthius), ×4; (*b*) *Palaemon lamarrei*, ×20.

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[1] Published with the permission of the Director, Zoological Survey of India, Calcutta.

characters, by the presence of an appendix masculina on the endopod of the second pleopod.

The appendix masculina presents a more or less uniform structure in all the Indian species of *Palaemon* examined by me except *Palaemon lamarrei* H. Milne-Edwards. It consists of an elongate, thin appendage arising from the angle formed by the junction of the appendix interna with the inner border of the endopod. In most of the species this structure, though longer than the appendix interna, fails to reach the apex of endopod by a considerable margin, and it is copiously provided with stiff hairs (fig. *a*).

The appendix masculina of *Palaemon lmarrei* (fig. *b*) differs from that of other species in the following features :

1. In the fully developed stage it is a long structure, in the usual position, extending as far as the apex of the endopod or even slightly exceeding beyond it.
2. Its apex is slightly inflated, and is provided with about half a dozen stiff hairs. In addition its inner edge has five or six scattered erect marginal hairs in the upper two-thirds of its length.

The only other recorded instance where the appendix masculina extends almost up to the end of apex of endopod is the figure of the second pleopod of a 25 mm. long male identified by Kubo[1] as *Palaemon boninensis* Stimpson. In this case, the structure appears to be more hairy than in *P. lamarrei.*

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA.
*October* 15, 1955.

KRISHNA KANT TIWARI

## 26. REPRODUCTION OF THE NOTOSTRACA[2]

The Phyllopod Crustacean (*Triops orientalis*) is extremely common in the rainwater pools on the Tableland of Panchgani, 4,378 ft., (Satara District, Bombay), but nothing is known regarding its habits or breeding. It may therefore be of interest to draw attention to a note on the 'Reproduction and Cytology of the Notostraca' by Alan R. Longhurst, Bedford College, University of London, on pages 671-680 (Volume 125) of the *Proceedings of the Zoological Society of London* for November 1955.

Both bisexual and hermaphrodite reproduction occur. The copulation of *Triops cancriformis* has been described by other authors and is said to be 'a rapid process, in which the male approaches the female laterally, and arches its body so that it grips that of the female in such a way that the ventral surfaces of the posterior regions of the thorax are opposed; for a few seconds the male moves convulsively, and then breaks away.

'Isolated hermaphrodite females readily lay viable eggs', but 'in bisexual populations copulation is necessary before the females will pass eggs into the brood pouches; females of such populations of *Triops granarius* and *T. australiensis* will lay no eggs in the absence of males'.

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[1] Kubo, I., *J. Imp. Fish. Inst. Tokyo,* **34**, No. 1, p. 17, Fig. 9 (1940).

[2] Published with the permission of the Director, Zoological Survey of India,

*Triops orientalis* of India is bisexual though the sex ratio is not known with certainty. No information is available about the structure and cytology of gonads in this species.

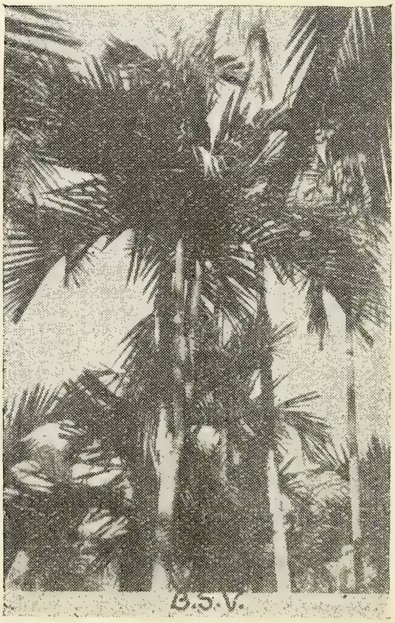
It is hoped that students in India will study this interesting problem which may throw light on the taxonomic status of this species which is regarded by Longhurst as a synonym of *T. granarius*.

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA, KRISHNA KANT TIWARI
*January* 2, 1956.

## 27. BRANCHING IN ARECA PALM, *ARECA CATECHU* L.

(*With a photo*)

Branching is the rule in the aerial stem of Doum-palm (*Hyphaene thebaica*) and a few other species of this genus. The stem in this plant forks several times in succession, which appear like dichotomies. These are not true dichotomies but the result of 'the development of an axillary bud into a branch equal in strength to the main stem' (Rendle, 1953). Branching in other palms is exceptional, and reports of this phenomenon have been recently made for *Cocos nucifera* (Vélez, 1954) and *Elais guineensis* (Lesage, 1955). Further, it has



been pointed out by Rendle (1953) that branching in palms may be caused as a result of injury to the terminal bud or due to replacement of flowering buds by leafy shoots.

During a recent field trip it was observed in a private garden at Kuppahalli, Krishnarajpet Taluk, Mandya District, Mysore State, that a specimen of Arecanut palm (*Areca catechu* L.) had three branches in all. The branches show normal growth and yield. The plant is 20 years old and 28 ft. in height. On enquiry it was learnt that the branches appeared 8 years ago, and to start with it had a single crown of leaves, as the other plants in the garden.

The three branches with their crown of leaves surround a central stump, which is about ½ a foot from the uppermost branch; the branches appear just above leaf scars at intervals of 1½ to 2 inches. The branching may be due to an injury to the apical bud, which is now represented as a stump, or may be the result of further development of axillary buds in the distal region into healthy lateral shoots thus replacing the apical crown.

BOTANY DEPARTMENT,
ST. PHILOMENA'S COLLEGE,
MYSORE,
*November* 3, 1955.

B. N. NARAYANA RAO
K. H. KRISHNA MURTHY
B. S. VENKATAKRISHNIAH

## 28. PTERIDOPHYTES OF COOCH BEHAR

Cooch Behar is a representative part of the North Bengal plain near the foothills of the eastern part of the Himalayas. It is situated at 26° 19′ N. and 89° 30′ E. The place is 145 ft. above sea level; the yearly rainfall is about 120 inches. The climate of the place is hot and humid; the temperature varies from 45°F. to 103°F. The soil is loamy to sandy and remains moist throughout the year. Epiphytic and terrestrial ferns are abundant. One of them is an uncontrollable weed.

Carl Christensen's 'Index Filicum' is followed in most cases for naming the ferns, and synonyms from Beddome's 'Ferns of British India' are quoted for the convenience of those who follow the latter. As for other pteridophytes Baker's 'Fern Allies' is followed.

### FERNS

1. **Ophioglossum reticulatum** Linn. Beddome p. 464.

Terrestrial, collected with spike during the rains. Found growing abundantly in meadows.

2. **Lygodium flexuosum** (L.) Sw.

*L. flexuosum* Sw. Beddome p. 457.

Large pinnately divided leaves are found climbing on shrubs and small trees. Abundantly distributed.

3. **Lygodium japonicum** Sw. Beddome p. 457.

Less common than *L. flexuosum*. Intermediate leaf forms are found and it is very difficult to separate the species from *L. flexuosum*. Possibly *L. japonicum* is a form of *L. flexuosum*.

4. **Adiantum capillus-veneris** Linn. Beddome p. 84.

Collected from damp shady regions. Abundantly found.

5. **Adiantum lunulatum** Burm. Beddome p. 82.

Semilunar pinnae obliquely attached to the rachis. Fronds propagate by rooting at the tips. Found growing on damp soil together with the former species. Abundant.

6. **Cyclophorus adnascens** (Sw.) Desv.

*Pyrrosia adnascens* Copeland. Copeland, Genera Filicum.

*Niphobolus adnascens* (*Polypodium adnascens* Sw.). Beddome p. 325.

Epiphytic, abundantly found on trees. Rhizome creeping, much elongated.

7. **Cystopteris setosa** Bedd. Beddome p. 70.

Terrestrial, erect plants. Somewhat membranous fronds, tripinnate. Less commonly found.

8. **Diplazium esculentum** (Retz) Sw.

*Anisogonium esculentum* Presl. Beddome p. 192.

Rhizome stout and erect. Terrestrial with large, much divided fronds. This is an uncontrollable weed growing everywhere. Young leaves are taken as vegetable by local people.

9. **Drynaria quercifolia** (L.) J.Sm. Beddome p. 341.

Epiphytic, most prominent fern flora on the trees, with dimorphic leaves.

10. **Dryopteris prolifera** (Retz) C.Chr.

*Polypodium proliferum* Roxb. Prain, D. Bengal Plants.

Scandent plants, fronds rooting at the tips and branching profusely from the axils of pinnae.

11. **Dryopteris subpubescens** (Bl.) C.Chr.

*Nephrodium molle* Desv. Beddome p. 277.

Terrestrial plant with large fronds pilose on both surfaces. Fronds membranous in texture. Sori smaller in number. Commonly found.

12. **Dryopteris unita** (L.) O. Ktze.

*Nephrodium cucullatum* Bl. Beddome p. 270.

Found commonly. Fronds coriaceous, pubescent beneath. Sori profuse. Fronds about 5 ft. tall.

13. **Leptochilus axillaris** (Cav.) Klf.

*Acrostichum axillare* Cav. Prain, D. Bengal Plants.
*Gymnopteris variabilis* var. *axillaris* Cav. Beddome p. 429.

Eiphytic, rhizome creeping on tree trunks, flat, green in younger parts. Fronds membranous, about one foot long.

14. **Polypodium clathratum** Clarke.

*Pleopeltis clathrata* Clarke. Beddome p. 348.

Found growing on shady moist walls. Fronds small membranous.

15. **Polypodium lineare** var. **simplex** Hook.

*Pleopeltis simplex* Sw. Beddome p. 347.

Found rarely. Epiphytic with large fronds.
(Identification of the specimen is doubtful as sori were not found).

16. **Pteris biaurita** Linn.

*Campteria biaurita* Pr. Beddome p. 116.

Rarely found. Terrestrial.

17. **Pteris longifolia** Linn. Beddome p. 106.

Found growing in abundance, specially in the crevices of old moist brick walls.

18. **Stenochlaena palustris** (Burm.) Bedd. Beddome p. 421.

*Acrostichum palustre* Bedd. Prain, D. Bengal plants.

Covers the whole of the host plant, so that the host seems to be a fern plant itself. Fertile pinnae very much reduced.

19. **Ceratopteris thalictroides** (L.) Brong. Beddome p. 123.

Grows abundantly on damp soil. Found in the rainy season.

20. **Marsilea quadrifoliata** Linn.

Found growing in the ponds, marshes and moist lands; abundant. Leaves used as vegetable. Soporiferous.

## FERN ALLIES

1. **Psilotum triquetrum** Sw.

A few plants are found growing on *Polyalthia longifolia* along with an orchid (*Dendrobium* sp.) in the main park. [Possibly this has come here from the south along with the orchid collection. Found to be growing there without the knowledge of the nursery men].

2. **Selaginella ciliaris** (Retz) Spreng.

*S. proniflora* Baker.

Very small plants, a few centimetres long. Spikes with two types of spores. Found growing on damp and shady soil or wall.

3. **Selaginella serpens** Spreng.

Plants with much branched stem. A blue tinge is found on the upper surfaces of the leaves. Growing on damp soil.

4. **Equisetum debile** Roxb.

Found in river beds and other shady moist regions.

I wish to thank Dr. S. K. Mukerjee of Indian Botanical Gardens, Calcutta, for his valuable help.

DEPARTMENT OF BIOLOGY,
VICTORIA COLLEGE,
COOCH BEHAR.
K. C. BISWAS

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## 29. THE TAXONOMIC VALUE OF THE ANDROECIUM IN THE GENUS *CASSIA*

The genus *Cassia* shows a great diversity in the characters of its androecium. These characters together with those of the fruit have been used in splitting this large genus into three subgenera namely *Fistula*, *Lasiorhegma* and *Senna* (Engler and Prantl, 1894). The subgenera have been further divided into several sections. Some systematists are inclined to raise the three subgenera to independent generic status, while others prefer to treat them under the same genus.

Detailed investigations by me of species representing all the subgenera have revealed a number of characters of the stamens and anthers which could be used to great advantage in the diagnosis of the various species. The characters in question pertain to gross features, structure and the mode of dehiscence of the anthers. Occasionally there exists a certain degree of variability within the limits of a few species but usually the entire androecium or some features of it are quite typical or characteristic of a species.

The taxonomic value of the characters of the anther, where they are widely variable, is quite well recognised in families like the Melastomaceae and the Ericaceae. Whereas in these families it is the different genera which show characteristic modifications of the anther and filament, in the case of *Cassia* such variability is well pronounced intragenerically among the different species. The following key, which comprises the thirteen species investigated in the present instance, is intended to indicate the utility of such characters for the purpose of the systematic delimitation of the species.

A. Stamens all fertile and antheriferous.
  B. Stamens markedly dissimilar in length of filament, size and form of the anthers. Anthers

of the outer whorl dehiscing by incomplete longitudinal slits, those of the inner whorl by sub-basal pores at the ends of thecal spurs. A typical fibrous hypodermis present (Subgenus *Fistula*).

C. Filaments of the three tall anterior stamens with prominent nodulose swellings about the middle. ... *C. nodosa* Ham.

CC. Filaments of the three tall anterior stamens without swellings.

D. The filaments of these three stamens broadly flattened. *C. fistula* L.

DD. The filaments of these three stamens slender and filiform. *C. marginata* Roxb.

BB. Stamens similar or dissimilar only in size. Anthers with broad flattened bilobed tips with mucronate apices and dehiscing by two sub-apical chinks which continue downwards as lateral sutures lined by intercoiled epidermal hairs which give the sides of the anther a shaggy, bearded or stitched-up appearance. A typical fibrous layer is wanting but a few epidermal cells may show fibrous thickenings (Subgenus *Lasiorhegma*).

C. Stamens 5, sometimes more, subequal. ... *C. absus* L.

CC. Stamens 10, alternately long and short. ... *C. mimosoides* L. and *C. kleinii* W. & A.

AA. Stamens rarely all fertile and antheriferous, usually the three posterior and sometimes the one anterior also reduced to staminodes ending in sterile blades. Dehiscence of anthers occurring by 1-2 apical or subapical chinks or pores. The hypodermis not fibrous (Subgenus *Senna*).

B. Fertile stamens 10, anthers dehiscing by 2 short subapical chinks. Lateral sutures present along the whole length of every anther. *C. glauca* Lam.

BB. Fertile stamens less than 10, usually 7, the rest staminodes.

C. Anthers without lateral sutures and smooth on the sides, dehiscence occurring by a solitary chink across the anther tip. ... *C. siamea* Lam.

CC. Anthers with short or long sutures and furrows on the sides, dehiscence occurring by 1-2 chinks or pores.

- D. Sutures continuous over the entire length of all anthers, dehiscence by a pair of chinks. ... *C. auriculata* L.

- DD. Sutures of some anthers continuous along whole length and in others limited to about $\frac{2}{3}$ length of the anther. Dehiscence occurring by a solitary broad gaping pore across the tip. ... *C. laevigata* Willd.

- DDD. Sutures variously limited to different lengths in all anthers.
  - E. The three anterior anthers dehiscing by two subapical pores, the others by 1 or 2 apical pores at the very apex. ... *C. obtusifolia* L
  - EE. All the anthers dehiscing invariably by 2 subapical angular pores situated well below the apex on the ventral side of the strongly flattened tip.
    - F. Sutures very short and usually limited only to the base of the anthers. ... *C. occidentalis* L.
    - FF. Sutures longer, running along the greater length of the anthers. ... *C. hirsuta* L.

## SUMMARY

The key given in this paper shows the great variety and systematic utility of the characters of the androecium in the genus *Cassia*. Of the three subgenera it is *Senna* that offers the largest number of characters for the delimitation of its different species. When more species become available for study and observation, it may be possible by using the characters of the androecium to evolve a suitable diagnostic key for all the species of *Cassia* occurring in India.

I am thankful to Rev. Father H. Santapau, St. Xavier's College, Bombay for suggestions, and to Professor P. Maheshwari of the University of Delhi for kind encouragement.

DEPARTMENT OF BOTANY,
UNIVERSITY OF DELHI, C. S. VENKATESH
DELHI,[1]
*December* 20, 1955.

LITERATURE

Engler, A. and Prantl, K. (1894) :—'Die natürlichen Pflanzenfamilien.' Leipzig.

## 30. NAME CHANGES OF A FEW BOMBAY PLANTS

Some of our Bombay plants have had their names changed of recent years, but this fact may not be known to some of our botanists who may not possess the necessary bibliographic references. The following notes are given in order to help interested botanists.

1. **Uraria rufescens** (DC.) Schindler in Fedde, Repert. Spec. Nov. 21: 14, 1925.

*Desmodium rufescens* DC. in Ann. Sci. Nat. 4: 101, 1825.
*Uraria hamosa* Wall. Cat. 5681 B, 1831-32, nom. nud.; Wt. et Arn. Prodr. 222, 1834.
*Hedysarum hamosum* Roxb. Hort. Beng. 57, 1814, nom. nud.
*Doodia hamosa* Roxb. Fl. Ind. 3: 367, 1832.

In a recent number of this Journal Santapau and Panthaki reported the occurrence of this plant in Bombay, under the name of *Uraria hamosa* Wall. Of the occurrence of this plant there can be no doubt, but the name *U. hamosa* is clearly illegitimate according to the Rule of Priority; Roxburgh's *Hedysarum hamosum* is the oldest name for the plant, but it is a *nomen nudum* in the sense of the International Code of Botanical Nomenclature, since it has no description of any sort, and is not described by reference to any previous description. *Desmodium rufescens* is the first and oldest valid name.

2. **Butea monosperma** (Lamk.) Taubert in Engler et Prantl, Pflanzenfamilien 3 (3): 365, 1894.

*Erythrina monosperma* Lamk. Encycl. 1: 391, 1783.
*Butea frondosa* Koenig ex Roxb. in Asiat. Res. 3: 469, 1792 & Pl. Corom. 1: 21, t. 21, 1795, & Fl. Ind. 3: 244, 1832; auct. indici passim.

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The combination *B. monosperma* is now generally accepted as the correct name of our *Pallas* tree; but the combination is often attributed to Otto Kuntze. This attribution is not correct. O. Kuntze in Rev. Gen. Pl. (1891) writes on page 202:

> '**Plaso** Ad. (1763) . . . *Plaso monosperma* OK. (*Butea monosperma* OK. olim=Erythrina m. Lam. . . .=Butea frondosa Roxb. 1795).'

This means that formerly O. Kuntze held the view that the plant ought to be called *Butea monosperma* O. Kuntze; but this view was not published until 1891, when the name was merely given as a synonym of *Plaso monosperma;* this method of publication is specifically condemned by Art. 43 of the International Code of Botanical Nomenclature.

3. **Gardenia resinifera** Roth, Nov. Pl. Sp. 150, 1821; Stearn in Blatter & Millard, Some Beautif. Ind. Tr., ed. 2, 83, 1955.

*Gardenia lucida* Roxb. Hort. Beng. 15, 1814, nomen nudum; id. Fl. Ind. 2: 553, 1824 et 1: 707, 1832; Fl. Brit. Ind. 3: 115, 1880.

The oldest valid name for this plant is Roth's of 1821; Roxburgh listed the plant in 1814 but without giving either a description or a reference to one. The name is changed in accordance with the Rule of Priority.

4. The common **Thunbergia** of Bombay.

The common white-flowered plant of Bombay is listed in our floras as *Thunbergia fragrans* Roxb.; Bremekamp in Verh. K. Akad. Nederl. Wet. II, 50 (4): 31, 1955 has shown that the plant listed in our floras as *Th. fragrans* is a mixture of two plants, *Th. fragrans* proper and *Th. laevis* Nees. The two species can be distinguished by the following key:

Ovary and capsule glabrous. Basal half of leaf blade on each side with two patent lobes. ... *T. fragrans* Roxb.
Ovary and capsule puberulous. The basal half of the leaf blade usually on each side with a single patent lobe, never with two lobes. ... *T. laevis* Nees.

The nomenclature of the latter species is as follows:

**Thunbergia laevis** Nees in Wall. Pl. As. Rar. 3: 77, 1832 et in DC. Prodr. 11: 56, 1847; Bremek. in Verh. K. Nederl. Akad. Wet. II, 50 (4): 51, 1955.

*Th. fragrans* Roxb. var. *laevis* Clarke in Fl. Brit. Ind. 4: 391, 1884.

*Th. fragrans* Cooke, Santapau, etc. non Roxb. nisi partim.

*Meyenia longiflora* Benth. in Flora 32: 558, 1849.

St. Xavier's College,
Bombay 1.
*December* 20, 1955.

D. PANTHAKI (Miss)
H. SANTAPAU, s.j.

## 31. EXTENSIVE LOSS OF WATER BY FOREST TREES IN THE DANGS FOREST

In a paper published by the present author in the *Journ. Gujerat Res. Soc.* (16 : 318, 1954) mention was made of extensive loss of water by *Ougenia dalbergioides* Benth. The loss of water was in fact so great that when the tree was placed between the observer and the sun, it appeared like a constant drizzle. In the month of October of this year I was again in the Dangs Forest and noticed that the 'rain' was not confined to *Ougenia*; it was noted also under *Mangifera indica*, *Grevillea robusta, Syzygium cumini,* and others. This phenomenon was observed by myself and my assistants almost every morning from sunrise to about 10 a.m. If one stood under the tree at that time, one's face and clothing were soon noticeably wet.

Another remarkable aspect of this 'rain' was that even trees growing in rather dry spots seem to be giving out great amounts of water. At the time our observations were made, it was not possible to assess the quantity of water lost by any particular tree, but it was quite clear that it was considerable; the temperature was noted as between 80 and 82 degrees F.

One simple explanation of this phenomenon is that the relative humidity of the atmosphere being very high (about 80% at the time) much of the surplus water taken up by the tree was released not in the form of water vapour but as liquid drops, which gathered at the ends of the leaves and reaching certain size or quantity fell to the ground. It is, however, a great puzzle, how to account for the large quantity of water lost by such trees. This phenomenon has not been observed by the writer in any other part of Bombay State.

ST. XAVIER'S COLLEGE,
FORT, BOMBAY, H. SANTAPAU, S.J.
*December* 17, 1955.

## 32. *DOLICHOS BRACTEATUS* BAKER

In the course of our studies on the Papilionaceae of Bombay, on which the junior author has been engaged for over a year, we have gathered some details which may be of interest to botanical readers of the *Journal*.

*Dolichos bracteatus* Baker is a plant of rather restricted distribution; Cooke in his Flora Pres. Bombay (1 : 381, 1902) considers it 'a very rare plant, the only specimens seen being those in Herb. Kew, marked "Konkan, *Stocks*".' The type sheet of the species is a rather dilapidated specimen, of which only one leaflet (out of three) and some flowers are preserved. However, in our field excursions we have had occasion to see and collect the plant in Khandala, Purandhar, Mahableshwar etc.; in all these places the plant is far from rare, large masses of leaves, flowers and fruits being available during the monsoon months; along the road down Fitzgerald Ghat at Mahableshwar it is one of the showiest plants in the second half of

August. Moreover, the local people collect the pods as an article of food, so that as soon as the monsoon is over it is impossible, or nearly so, to collect either flowers or fruits. This may explain why the plant has been so seldom noticed by Bombay botanists.

The flowers are about the largest among the Papilionaceae, and certainly the largest among the *Dolichos* species of western India; generally flowers are bright purple; occasionally we have noticed pure white flowers.

The nomenclature of the plant needs adjustment to bring it into line with the International Code of Botanical Nomenclature. J. G. Baker in Hook. f. Flora of British India (2 : 210, 1876) listed the plant under the name *Dolichos bracteatus* Baker; previously, in 1831-32, Wallich in his Numerical List under No. 5554 had published another *Dolichos bracteatus,* which Baker himself makes the basonym for *Rhynchosia bracteata* Baker. It is clear, therefore, that in the opinion of Baker, the two plants bearing the same name are quite different.

According to Art. 74 of the Code, *Dolichos bracteatus* Baker must be rejected as a later homonym of *D. bracteatus* Wall. In consequence the plant needs a new name and, for want of an older legitimate one, we propose the following:

**Dolichos ghaticus** Santapau & Panthaki, nom nov.

*D. bracteatus* Baker in Hook. f. Fl. Br. Ind. 2: 210, 1876; Cooke, Fl. Pres. Bombay 1: 381; Santapau in *Rec. Bot. Surv. Ind.* 16 (1): 81 (non Wall. 1831-1832).

The new name is given to commemorate the fact that the plant seems to be endemic on the Western Ghats of India.

ST. XAVIER'S COLLEGE,
BOMBAY 1,
*December 2, 1955.*

H. SANTAPAU, S.J.
D. PANTHAKI (MISS)

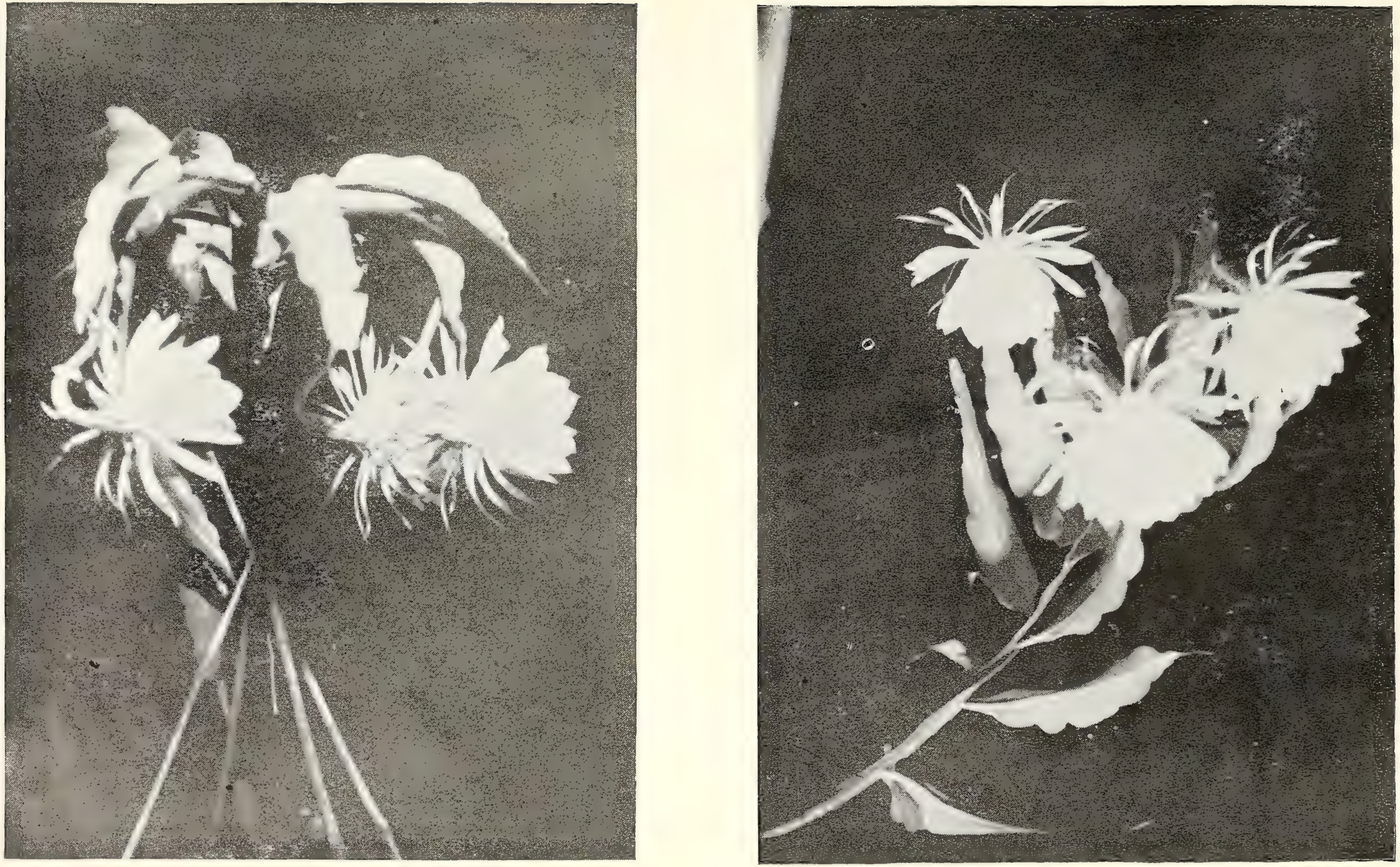
## 33. FLOWERING OF 'BANGA RAJA' NIGHT FLOWERING CACTUS

(*With a plate*)

The Chief of Police, Kuching, Sarawak, sent me a leaf of the night flowering cactus in 1952, with the following notes:

'Banga Raja flowers every five years. Banga is Malay for flower and Raja, a prince. It is a Prince of Flowers when it blooms. The flower is large bell-shaped, dark purple red. It only flowers at about 1 p.m., and the flower is dead by the morning.'

But here in Rangoon, it bloomed twice in 1954. During the current year it has bloomed already four times. On the first occasion in August, there were six flowers on the first night, and one flower on the following night. On the present occasion—the fourth time—there were three flowers on the first night (21st October 1955) and one flower on the following night.



Flowers of 'Banga Raja'—a night flowering cactus (*Cereus* sp.)

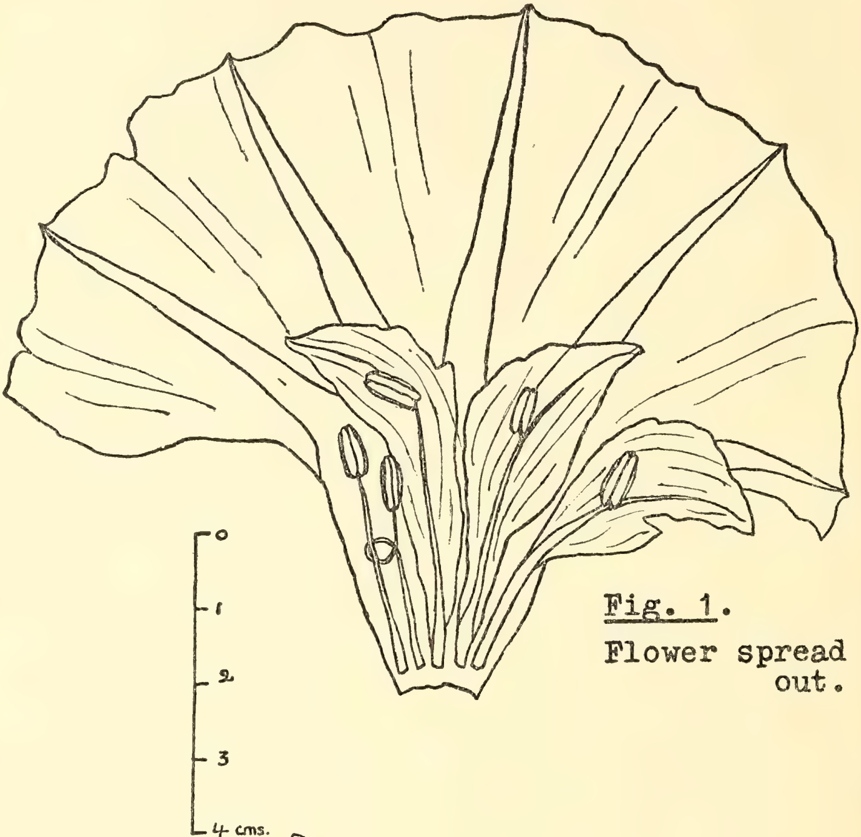


Fig. 1. Flower spread out.

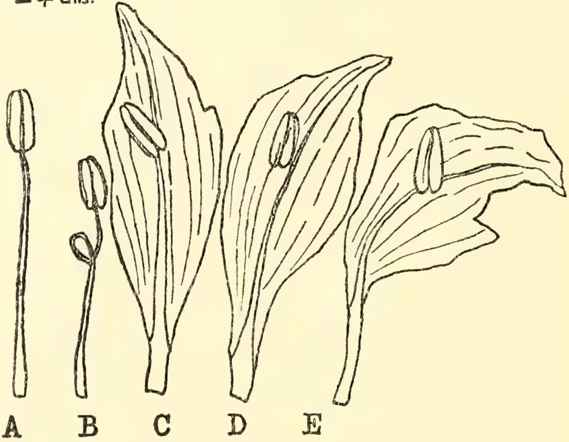


Fig. 2: Petaloid stamens.

The flower is pure white and sweet scented. On all occasions it blooms before 10 p.m. and on the 8th, 9th, or 10th day of the moon. The Rangoon climate may have suited the plant.

The photographs were taken at 21.00 hours on 21st October 1955.

25-Inya Myaing Road,
University P.O.,
Rangoon-Burma,
*November* 12, 1955.

TUN YIN,
B.C.S. (Retd.)

[*Cereus* is a well-known night-flowering cactus; several species have been introduced from tropical America, and are rather showy but for the unfortunate habit of flowering at night, when flowers may pass unnoticed.—Eds.]

## 34. PETALOID FILAMENTS IN *IPOMOEA RUBRO-CAERULEA* HOOK.

(*With a plate*)

The following peculiarity was observed while examining some specimens of *Ipomoea rubro-caerulea* Hook. grown in our garden. Out of a total of about 55 flowers that opened one morning, about 20 of them showed that the filaments of their stamens were modified into prominent petaloid structures. This modification was not uniform in all the flowers. In the accompanying diagram of an abnormal flower, fig. 1 shows the corolla split open and spread out to show the petaloid filaments; fig. 2 shows the five stamens all are attached to the base of the corolla by the lower portion of their filaments. Stamens A and B are normal, except that B has a twist in the upper part of its filament; stamens C, D and E show the petaloid modification. In all the stamens the anthers are normal; in the modified ones, they are attached about the middle of the petaloid structures, the filament at the base of the anthers being but about 2.5 mm. long.

This modification varies considerably from flower to flower; in some flowers all the five stamens are changed; in some flowers the modified stamens are attached to the corolla base only; in others, however, the petaloid structure has fused with the corolla for nearly all its length. The shape and size of the modified stamens varies from plant to plant, and even from flower to flower or even within the same flower; however, the colour is always blue, the same as the corolla. Further in flowers showing this modification the filaments are completely glabrous or hairless, which is not the case with normal flowers. All the petaloid stamens show a strong median band similar to the ones on the corolla.

The plant has been examined on successive days, and the same peculiarity has been noticed in some of the flowers that opened each day.

Loyola College,
Madras, 31.
*December* 10, 1955.

J. PALLITHANAM, S.J.

[This is an interesting case of 'reversion'; it is generally accepted by botanists that the various parts of the flower are modifications from the normal leaves of a plant; the stamens with their slender filaments are a further stage in this evolution of the floral structures. Occasionally some parts of the flower may revert or go back either to the original leaf form, or to some intermediate stage as in the present case. Such irregularities seem to be rather common in garden plants.—EDS.]

## 35. THE NAME *HOYA PENDULA*

In the botanical literature of India, two plants go under the name *Hoya pendula*: (*a*) Wt. & Arn. in Wt. Contrib. 36, 1834; (*b*) Wt. in Icon. t. 474, 1840-43.

It is clear that in accordance with Art. 74 of the International Code of Botanical Nomenclature, the name can only be retained for the first plant, the other being a later homonym in the sense of the Code and therefore an illegitimate name.

The nomenclature and synonymy of these two plants is, therefore, the following:

(*a*) **Hoya pendula** Wt. & Arn. in Wt. Contrib. 36, 1834, excl. synon.; non Wt. Icon. 1840-43.
*Hoya wightii* Hook. f. in Fl. Br. Ind. 4: 59, 1883; Santapau, Fl. Khand. in *Rec. Bot. Surv. Ind.* 16 (1): 175, 1953.
*Hoya pallida* Dalz. & Gibs. Bomb. Fl. 152, 1861.

(*b*) **Hoya iconum** Santapau, nom. nov.
*Hoya pendula* Wt. Icon. t. 474, 1840-43, non Wt. & Arn. 1834; Hooker in Fl. Br. Ind. 4: 61, 1883.
*Asclepias pendula* Roxb. Fl. Ind. 2: 36, 1832.

ST. XAVIER'S COLLEGE,
BOMBAY,
*November* 25, 1955.

H. SANTAPAU, S.J.

## 36. TOBACCO WITHOUT NICOTINE

Whilst going through some of the journals in the library of the Botanical Survey of India in Calcutta recently, I found a note that may be of interest to the readers of this journal. The note was reproduced from *Revue Intern. des Tabacs*, October 1952, in *Agronomie Tropicale* 8: 207, 1953.

If a tobacco plant, i.e., a stem, is grafted on a tomato rootstock, the resultant tobacco plant is completely devoid of nicotine. Inversely, if tomato stems are grafted on rootstocks of tobacco plants, the resultant tomato plants contain some nicotine. The conclusion drawn from similar experiments is that nicotine is formed in the roots of the tobacco plant.

BOMBAY,
*October* 20, 1955.

H. SANTAPAU, S.J.

## 37. A PETRIFIED MONOCOTYLEDONOUS INFLORESCENCE FROM THE DECCAN INTERTRAPPEAN BEDS, CHHINDWARA, M.P.

In the present note is described a petrified monocotyledonous inflorescence collected from Mohgaonkalan, Chhindwara District, M.P., India, where the Eocene beds of the Deccan intertrappean series are exposed.

The inflorescence is a raceme of shortly pedicellate pistillate flowers, arranged in acropetal succession, along six alternating vertical rows on a six angled inflorescence axis. Each flower has a polysepalous calyx consisting of six sepals, one against each carpel. Petals and stamens are absent in all the flowers, young or old. The pistil is hexacarpellary apocarpous. The six carpels of a flower are placed round or partly fused with a flat and six angled central axis, which is the continuation of the floral stalk. The ovaries are drawn out at the apex to form a short conical structure, the style. The central axis or the carpophore gradually broadens out at the top to cover the six ovaries partly. On the top of the flower there lie thick flat ribs, one on each ovary, radiating out from the centre of the flower to the stigma of each carpel.

The anatomy of the inflorescence axis shows a typical monocotyledonous structure. The cellular structure of most of the floral parts is well preserved and could be studied in detail. Sclerotic tissue is abundant, both in the inflorescence axis as well as in the floral parts.

On the basis of the floral structure it is proposed to assign the present specimen to an extinct genus under the Order Helobieae, which is an assemblage of primitive or reduced Monocotyledonous families, mostly aquatic. The fossil shows nearest approach to some genera belonging to the present day Juncaginaceae.

A fuller account of the specimen is being published elsewhere.

LECTURER IN BOTANY,
COLLEGE OF SCIENCE,
NAGPUR.
*March* 22, 1956.

J. K. VERMA, M.SC.

## 38. ON A NEW PETRIFIED FLOWER *SAHNIPUSHPUM SHUKLAI* SP. NOV. FROM THE INTERTRAPPEAN BEDS OF MOHGAONKALAN IN THE DECCAN.

This note describes a new petrified flower from Mohgaonkalan (22° 1′ N; 79° 11′ E), Chhindwara District, M.P. The description is based on nearly thirty specimens, the first of which was collected by Professor V. B. Shukla and named as *Sahnipushpum*. Later, during subsequent years, many more specimens were collected by the author and studied both in longitudinal and transverse sections. The flowers are bisexual, sessile, with the receptacle forming a cup-like hypanthium enclosing the ovary; sepals not seen; petals O; stamens probably many, perigynous near the mouth of hypanthium, incurved, anthers small, basifixed, dehiscing by longitudinal slit, pollen grains ellipsoidal; ovary superior, spherical in cross section, five-locular, each locule incompletely partitioned by half septum, central axis disorganised in the middle part of the ovary; each half loculus containing one ovule, placentation probably basal, style thick, traversed by a stylar canal, ending in an umbrella-shaped plate. Dehiscence of the fruit septifragal, seed endospermic. Anatomical details of most of the floral parts are fairly well preserved.

The affinities of the flower have been traced to the family Sonneratiaceae—Order Myrtiflorae, with a near approach to the genus *Sonneratia*.

The complete paper on this unique specimen is being published elsewhere.

LECTURER IN BOTANY,
COLLEGE OF SCIENCE,
NAGPUR.
*March* 22, 1956.

J. K. VERMA, M.SC.

## 39. MODEL MILES ON ROADS

In an editorial dealing with this subject (*Scottish Field*, July 1955) we are informed that the idea of a Model Mile was instituted in America five years ago and landscape architects drew up plans free of charge, while business concerns made liberal contributions towards the funds, and different communities got together to raise money to ensure the success of the project. Where a country depends more and more on its increasing tourist industry it is essential that roads be made attractive. Apart from this it is surely the duty of man in this hot country to provide needed shade for both man and beast? Model roads, were they to be provided in as many parts of the country as possible, would arouse a civic sense in the matter. At the present time we can see in many parts the lopping of avenue trees for fuel and even the felling of them for the same purpose.

In 1952 the Hon'ble Mr. K. M. Munshi, the then Union Minister for Agriculture and Forests, wrote, '. . . . tree mindedness is growing, not yet grown; and it can only grow by Vana Mahotsava becoming a part of our national faith . . . . If India becomes Vana-Mahotsava-minded, she will live; not otherwise . . . .'

C/O LLOYDS BANK LTD.,
39 PICCADILLY, W. 1.,
*December* 11, 1955.

R. W. BURTON
*Lt.-Col.*, (Retd.)

## 40. DUTIES OF MEMBERS OF THE SOCIETY

Are you an active member,
The kind that would be missed?
Or are you just contented
That your name is on the list?

Now, as on many occasions in the past, our editors are in need of contributions from members of a popular nature. 'The Society is a mutual one, the more the Society benefits, the more the member benefits. The Society is finding it difficult to procure voluntary contributions of a popular nature. The Society appeals to its members for this assistance and support .' . . . . 'Again and again we have stressed that no lofty literary attainments are necessary for writing for the *Journal* .' . . . . 'We can meet much of the criticism that the journal is too technical if only members would take the trouble to send us notes of anything that has excited their interest or curiosity on holiday treks, or shooting or fishing trips, or may be even on the way to office. The cultivation of real interest, of habit of observation and an enquiring mind is what is wanted and is not difficult to acquire.'

In 1952 the present writer made a note, 'The real basis of a successful journal and a successful Society is more co-operation from many members who do not actually help the Society. The duty of membership goes considerably further than just reading the *Journal*'.

It is hoped this appeal may have useful results.

c/o LLOYDS BANK LTD.,
39 PICCADILLY, W. 1.,
*December* 11, 1955.

R. W. BURTON
*Lt.-Col.,* (Retd.)

# GLEANINGS

EXTRACTS FROM I.U.P.N. BULLETINS. SELECTED AND ANNOTATED BY R. W. BURTON

### Insecticides

In Essen, Germany, Dr. Wilfried Przygodda has just published an excellent monograph on the damage that insecticides and fungicides cause to wildlife, especially to birds. The report is accompanied by a bibliography, both references and text quoting copiously from the papers presented at the I.U.P.N. Technical Meeting at Copenhagen in 1954.

December 1955.

### Erosion

'Soil degradation is essentially Man's doing.

'In most cases, when left to her own devices Nature can tend her own wounds comparatively quickly and more or less adequately.

'Forests—or rather vegetation in general—are the surest remedy for erosion in all its forms.'—A. Oudin.

In the sub-continent of India, Nature can be aided by sowing of both indigenous and exotic grasses; and eroded hillsides can be speedily reclaimed through planting the quick-growing *Trema orientalis,* also *T. politaria.*

### Education

'In our opinion, conservation ought to be a compulsory part of school curriculums . . . With some exceptions, the graduate's ignorance will increase with age, and the mechanical engineer, the physicist, the chemist, or whatever the school-child eventually becomes, will only give nature casual attention, if any.

'For him a waterfall will be valued in kilowatts, a tree by its cellulose weight. A bird will be considered merely as a poetic symbol—execrable thing that it is, and doubly useless since the spread of insecticides. . . . . . 'Then the help of first class specialists, who have a practical knowledge and not only a theoretical one, must be obtained. The invalid must be operated on before he dies.'—J. Orioton.

### Population

Excerpts from a sermon on Science and Ethics delivered by the Archbishop of York:

'It is only when food is no longer the chief preoccupation in life and the struggle for bare survival is relaxed that man has leisure to concern himself with the quality of life. Only then will it be possible to educate him into a sense of parental responsibility which will prevent him from bringing into the world more children than he can reasonably hope to support. For however great may be the food supplies of a country, the growth of population will soon again outpace them if parentage is without foresight . . . . Side by side with the aid which science can give in the production of food and against disease, there must be moral and religious education in both the responsibilities and restraints of parenthood. The quality of life is more important than numbers'.

Extract from 'Controlling Human Numbers' (prepared by a study group of 'Political and Economic Planning', P.E.P., London.

* * * *

### THE ABOMINABLE SNOWMAN: THE ORIGIN OF THE NAME

A LETTER TO THE EDITOR, *Daily Telegraph and Morning Post,*

SIR.

Peterborough's note about the Abominable Snowman makes it a matter of interest to explain how that odd name came into being.

The first report of these peculiar footprints found in the Himalayas was made by a friend of mine, Col. Howard Bury, who had been a political officer in Tibet, and who took part in one of the earlier expeditions to Everest. He was the first person ever to see them—at least the first European.

When lunching with him two years ago at his villa in Tunisia I asked him what he thought about them. He laughed and said the story of the Abominable Snowman had originated in a report he had made to his base and had completed with marks of interrogation and exclamation, showing that it was not to be taken too seriously.

But when the message was telegraphed to India these marks were, of course, omitted and the receiver of the message took it as genuine.

Brockham, Surrey.
*January* 20, 1956.

Yours faithfully,
E. J. Bridges, *Lt.-Col.*

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### FROM 'NILGIRI SPORTING REMINISCENCES, BY AN OLD SHIKARRI': 1880.

(On page 61 he records that the Sloth Bear is remarkably fond of white ants and may be found near their nests). 'A well known Nilgiri sportsman once suddenly came upon a bear at work upon one of these anthills. Bruin was hard at his labor with his head and arms far down in the bottom of the nest, with only his stern high up and hind legs in a kneeling posture visible—a most undignified and helpless position—and was so intensely absorbed with his work that he was entirely unconscious of the proximity of the 'man with the gun,' who walking right up to his black friend gave him a rousing kick *a posteriori,* and as he was struggling out of the hole to resent the insult was quickly polished off on the spot.

'Another very curious incident connected with white ants' nests and resulting in the death of a bear happened in the woodland on the Westbury Estate, Seegoor, about eighteen months ago. One day the overseer of the Estate, observing a number of vultures, kites, etc. collected and wheeling over a certain spot not far from the plantation, went to the place indicated by these birds, and perceived a horrible stench of carrion. On looking about, he soon found a black mass of hair, skin and bones at the foot of a white ants' hill, which, on further examination, proved to be the remains of a bear far advanced in decomposition. The head and shoulders he found to be jammed into the mouth of a large cavity at the foot of the ants' nest; the other half of the body and hind legs erect in the air. The animal must have been digging away and burst suddenly head foremost into this cavity into which he got wedged, without the room or power to use his muscular fore-arms to extricate himself, and so died from suffocation, regularly trapped. I visited the spot soon after the occurrence and was thus able to verify the position of the body and all the particulars of the account. . . .'

## Extracts from 'LETTERS ON SPORT IN EASTERN BENGAL' BY FRANK B. SIMSON (published in 1886 and relating to experiences from 1847 onwards). SELECTED AND ANNOTATED BY HUMAYUN ABDULALI

*Page* 176: The junglefowl of Eastern Bengal is mentioned as having white ear lobes while the birds which he shot at Cuttack had red ear lobes.

[According to Fauna, subsp. *murghi* (type locality Bihar) has the lappets white sometimes touched with pink, while *robinsoni* (of Sumatra) is said to have them red or deep fleshy pink, not white. It is added, however, that according to Robinson and Kloss this character is not of much value.]

*Page* 142: Records shooting 'two of those curious bristly hares *Lepus hispidus*' near Mymensing and adds 'except sportsmen who have shot about Dacca and Mymensing I never met anybody who ever knew anything about the animal at all, and Jerdon's account is meagre'.

*Page* 124: 'Tigers are omnivorous. From habit and preference they prefer to feed on deer, hogs, and cattle killed by themselves, but they will eat any dead animal they come across. I have just shown that they eat the dead bodies of their companions; I have proved that in the inundations they catch fish, turtles, crocodiles, and large lizards. I believe they will occasionally eat sugar-cane and maize; but the most curious thing I ever knew them eat was grasshoppers. I once killed a tiger whose paunch was crammed full of grasshoppers or locusts;

nearly all birds, and fish, and deer, and cats eat grasshoppers, but it was new to me that a tiger should catch and eat several pounds of these insects at once.'

*Page* 201: 'Leopards often resort to trees. Once a party of us was taken to an old tree on which vultures had nested for many a year, and we were assured that a leopard lived in the huge faggot-looking pile. We were on elephants. Something apparently was in the nest; one of the party fired into it, and immediately a leopard half ran and half fell down the tree; as soon as he reached the ground he received a volley and was finished off.'

*Page* 205: Records an occasion when sixteen male hog-deer were shot in a day!

*Page* 210: 'The next place I got to (on elephant) was a dry teelah covered with grass about six feet high; here there were only a few inches of water. I never could have believed that so many wild deer and animals could have been so crowded together. Khyah partridges were rising and screaming at every step, and all around me I could see horns moving about; the grass was high enough to conceal the bodies of the swamp-deer, but I could see their horns. As soon as the first astonishment ceased, I began to consider which pair of horns was the finest, then getting rather close to the animal, and judging as to his neck and shoulder, I fired. In this way I soon had killed four magnificent bucks; but it was mere murderous slaughter, there was no sport, nor pursuit, nor pleasure in these proceedings. Four large deer were quite as much as I could dispose of in that hot weather, among the boatmen, mahouts, and attendants. I padded the stags and gave up the pursuit of them, and thought I would make a bag of khyah partridges. These birds, all wet and with heavy plumage, flew slowly; in ten minutes I shot three brace; but the men on the elephants knocked over three birds with sticks in the same time.'

*Page* 214: 'To the man who has only shot black partridges the sudden bouncing whirr and scream of the khyah partridge out of the thick tall grass near the swamp is so disconcerting that many a one misses his khyah . . . . they go in pairs in the dry weather and congregate in numbers in the rains; they are never found far from swampy ground or places that for a great part of the year are either under water or swampy; they perch habitually in bushes, . . . . is very noisy at times; but his scream is unmelodious and no pleasant memories are attached to it.'

*Page* 215: 'The quail is a bird which is most uncertain; for two or three years running you may hardly meet with a trace in the most eastern districts, but in the third or fourth year you will find them absolutely swarming, especially in February—you will kick them up under every bush in the garden and find the long rice-stubbles almost alive with quail. To the westward they are more regularly abundant; but even there I believe there are regular quail-years . . . . I have put them up at nearly every step of the horse; I have struck at them at times with the hog-spear. In the afternoons I have gone out and shot between twenty and thirty brace; but there is little sport in the pursuit: the bird rises quite close and flies generally straight; some nice double shots are offered; but there is a sameness in the shooting, and with small charges of powder and No. 8 or No. 10 shot you can scarcely miss. I have no record of what other men shot; but, according to my memory, I have known two guns shoot more than eighty couple of quail in a forenoon on the plains of Parbuttia, while most of us were hunting hog.'

*Page* 216: 'At Dacca they (Bengal florican) were to be found in places I knew of; in Mymensing they were numerous, and on the Brahmapootra plains plentiful: but in Purneah, both north and south, they were exceedingly numerous; I have seen fourteen in the air at one time, and they breed in Purneah and stay there all the year . . . . Some are most delicate eating; but I have tasted floriken which were coarse and strong.'

*Page* 224: The eggs of the watercock (*Gallicrex*) 'are taken and put into the half of a cocoanut-shell lined with cotton; this is bound over a man's stomach and so the bird is hatched out. It is brought up tame and taken into the high rice, where it calls with an extraordinary sound, more like the bellow of a bull than the note of a bird. The wild males answer and bellow in return; when they come near, the tame bird is let loose and runs through the thick rice till it meets its adversary; both birds then fight and entangle each other in their long claws, and the native then catches both together and places the tame bird again in his cage to call another. A really good khora is a very valuable bird'.

*Page* 233: 'The pink-headed duck is a rarity and prize; I shot numbers in Purneah because I made them a special study, and I introduced Jerdon to the first pair he ever handled in the flesh. I was resting for the night, when travelling slowly with my goods and chattels towards the head station of Purneah, at a small staging bungalow; before sunrise next morning I was standing, wearing only nightshirt and pyjamehs, in the doorway watching two floriken, when a party of dark-looking ducks, with rosy-pink feathers under their wings, alighted in a tank close by. I seized my gun and went after them; as I was without anything on my head or my feet, I easily got close to them in the sedges and shot a pair of ducks quite unknown to me. These were pink-headed ducks (*Anas caryophyllacea*). I never met with them save in Purneah and the neighbouring parts of Maldah: they are not particularly good to eat, but they are regular ducks exactly of the Mallard type. I suppose these were the rarest ducks I ever shot; they are resident in Purneah all the year and breed in the grass-jungles'.

*Page* 246: 'A planter at Purneah told me that he once turned a wild sow out of grass with a litter of young ones. A larger python made a dart, as the planter thought at one of the squeakers and enfolded it in his coils. The planter then shot the snake. As it uncoiled it appeared that it had caught two young pigs in its deadly grasp; they were both quite dead, though the snake had only that instant enfolded them.'

*Page* 249: 'When first I went to Mymensing several colonies of foxes lived under the houses and offices in the station; it was pretty to see them playing in the evenings. They cared nothing for ordinary dogs; but after coursing hares came into fashion and swift English greyhounds were introduced the poor little foxes had a bad time of it and disappeared. . . . I once tried to find out what these foxes fed upon. I knew several of their earths in high sandy spots, and I was astonished to find that they fed apparently almost entirely on doves. Doves are very common; but as they roost in trees and are active and wary, it was curious that the little fox should be able to catch these birds in such numbers.'

# NOTES AND NEWS

At the Annual General Meeting of the Helminthological Society of India held in Agra in January 1956 a Committee was appointed to draw up a scheme for a National Parasitological Laboratory in India, under the chairmanship of Dr. G. S. Thapar, lately Professor of Zoology, Lucknow University. Particulars of the Helminthological Society and the proposed laboratory may be obtained from its Honorary Secretary and Treasurer, Dr. B. S. Chauhan, c/o. Zoological Survey of India, 34 Chittaranjan Avenue, Calcutta 12.

* * * *

The reference to the name *Presbytis geei* on p. 252 of the *Journal* for December 1955 (Vol. 53, No. 2) was premature and is regretted. Mr. Khajuria of the Zoological Survey of India informs us that his description of this new langur has not as yet been published.

* * * *

It might interest members and others to know that a Hydroponic Information Centre has been opened at P.O. Box 31, Bombay. (Soilless Cultivation of Crops in India by J.W.E.H. Sholto Douglas in *Nature,* Vol. 175, May 21, 1955.)

* * * *

The Sir Dorab Tata Gold Medal has been awarded to Dr. M. L. Roonwal, M.Sc., Ph.D. (Cantab.), F.N.I., Forest Entomologist at the Forest Research Institute, Dehra Dun, for his important contributions to the Science of Zoology during the period 1952-54. The citation makes special reference to Dr. Roonwal's outstanding work on termites and locusts, in both their scientific and economic aspects.

* * * *

The 2nd meeting of the Bird Wing of the Indian Board for Wild Life was held in Bombay from 14-16 March 1956 under the chairmanship of Mr. Sálim Ali.

One of the principal items on the agenda concerned the flamingo breeding grounds in the Great Rann of Kutch. These are believed to be in jeopardy due to the recent construction of a solid bund across the Little Rann for the Kandla-Deesa Railway, which, it is alleged diverts the outflow of the monsoon waters of the Banas River and its tributaries away from the birds' breeding grounds, rendering them uninhabitable. The Wing authorized the Chairman and the Technical Secretary, Dr. B. Biswas, to make an on-the-spot investigation and report on the position.

* * * *

A number of horns, antlers and skulls of various species of Indian deer, antelope, etc. are available. The Society would be glad to give them away ex site to any educational or other institute.

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# SUNBIRDS AND HUMMING-BIRDS

BY

J. BERLIOZ

*Museum National d'Histoire Naturelle, Paris*

(*With six text figures*)

Over a great part of the world, in the eastern as well as the western hemisphere but more abundantly in the tropics, are found some birds notable for their very small size, which are chiefly adapted to feed from flowers and consequently concerned with their pollination and the natural spreading of plants. In the Old World these are the Sunbirds (family Nectariniidae); in the New World the Humming-birds (family Trochilidae). Although they represent two quite distinct avian types and show highly divergent phylogenetic affinities, they are very often confused owing to the apparent similarity both in their morphology and their biology. But the sunbirds exhibit all the characteristics of a true passerine type, while the humming-birds are more closely related to the picarian type. In the old classifications they were generally associated together, an arrangement now considered to be entirely unwarranted and out of date.

The similarities, of course strictly superficial and adaptative, are:

1. In the reduction of size, the largest sunbird (the West African *Dreptes thomensis*) being about the size of a sparrow, the largest humming-bird (the Andean *Patagona gigas*) that of a swift. The smallest sunbirds (the South Indian *Cinnyris minimus* and the West African *Cinnyris minullus*) scarcely exceed the size of a common bumble-bee, the smallest humming-birds being still more diminutive, the Cuban Hummer *Calypte helenae* being the smallest of all known birds.

2. In the shape of the bill, which is thin from the base, tubular, more or less elongated (the 'Sabre Humming-bird', *Ensifera ensifera*, possesses the longest bill compared to general size among all birds), acutely pointed, either straight or downcurved, or even upturned in some humming-birds. In close correlation with such a type of bill, the tongue is very long, thin, more or less protractile and tubular, bifid at the distal end, and used by the birds for obtaining their nectar food.

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3. In the brilliancy of plumage, at least among the adult males, since sexual dimorphism is a most frequent but not absolute rule in both groups. The most highly differentiated feathers have often a scale-like appearance and a peculiar microstructure, which is the origin of the iridescent gloss and varied effects of light-rays, for which these little creatures are celebrated from olden times as some of the most handsome and beautiful of all animals.

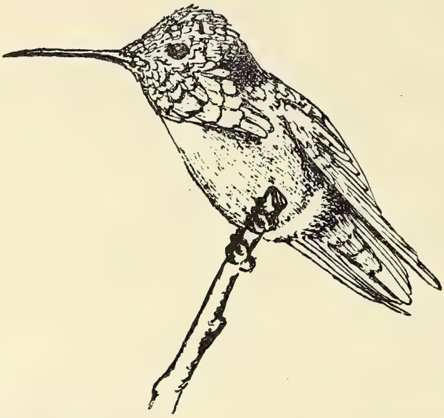


Fig. 1. One of the smallest known birds: Costa's Humming-bird (*Calypte costai* ♂).

But, when examined more closely, and particularly from their anatomical and morphological structure, both types of birds show obvious distinctions which make them in fact very easy to differentiate comparatively, not only in the hand but also in nature.

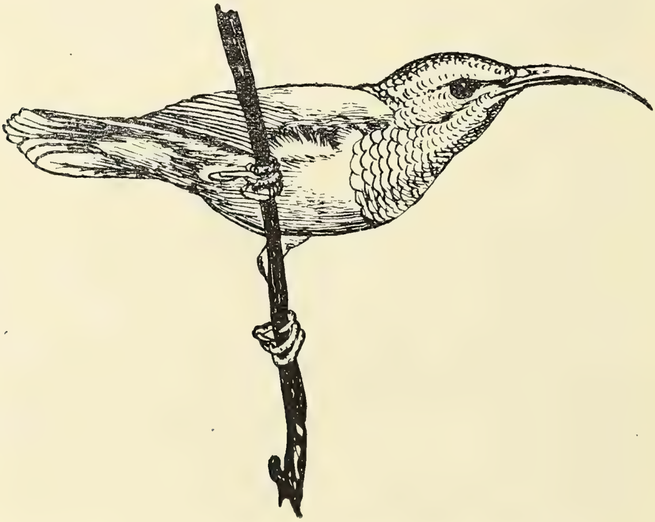


Fig. 2. An African Sunbird: *Cyanomitra verticalis* ♂.

The wings, tail and legs are quite differently shaped. Although in both groups the number of primaries remains the same—ten—the wing of the sunbird has the common, rounded structure of the passerine type, with the third and fourth primaries the longest. In the humming-bird, the wing is quite peculiarly oar-shaped, with a reduced number of secondaries, a very short humerus, and the first primary the longest (exceptionally the second). The tail in the sunbirds, typically passerine, is always composed of twelve rectrices, all of them normally shaped even if elongated; in the humming-birds, the tail has only ten rectrices, several of which are in some cases extremely differentiated compared with the normal type. The legs of the sunbirds are the normal legs of passerine birds, with comparatively long tarsi; in the humming-birds, the tarsi are greatly shortened, their strength varying in accordance with the several types, generally with very sharp claws.

The tongue, long and bi-tubular in both groups, a feature closely correlated with their way of feeding, shows an embryonic and anatomic development which is not the same in both of them.

The metallic feathers themselves, in spite of the similarity of their glossy tints, are quite different in either group, even from their external appearance and still more so from their microstructure when viewed under a strong lens. On the whole, if the various shades of green seem to be the most generalised ground-colour in both groups, it is quite obvious that this metallic colouring varies distinctively within each of them, the plumage of the sunbirds often exhibiting, besides the metallic appearance, some bright pigment-colouring such as red or yellow, which is entirely unknown among humming-birds.

Sexual dimorphism occurs as a rule among the sunbirds with but very few exceptions: in this family the females never become really andromorphic, but in several species the male retains a dull gynemorphic

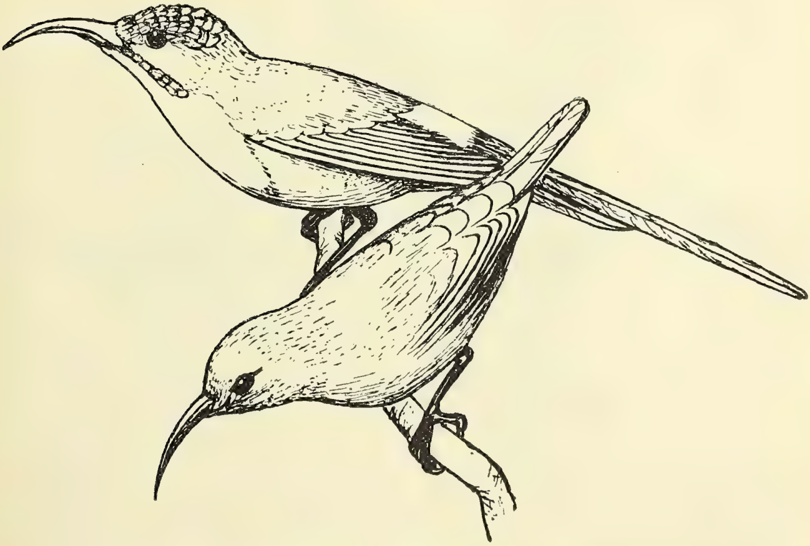


FIG. 3. An Asiatic Sunbird: *AEthopyga siparaja* ♂ and ♀.

appearance. In this regard the humming-birds exhibit a much more varied tendency. Both sexes are sometimes very much alike, and this not only among the dullest, but also among the most brilliant of them, as for example the 'Rainbow', *Panterpe insignis,* from Costa-Rica, and the Antillean *Eulampis jugularis.*

## Food and Habits

In their way of life, the search and the quality of the food are the most prominent features which make these two types of birds so often and so easily confused by people who are not specialists in ornithology. Both groups take their food chiefly from flowers and are well known as frequenting freely gardens and all kinds of cultivated areas where they may find an abundance of flowers. Therefore they have rapidly become familiar and popular animals even in the big towns: the sunbirds in Africa and Asia, the humming-birds in America.

But, if these birds are so much attracted to flowers, it is not exclusively in quest of their natural liquid secretions as was formerly believed, but also for catching the many tiny insects which are to be found inside the floral envelopes, which are themselves attracted by those secretions. It is a well-established fact now that the animal food is still more necessary to them than the vegetarian one, and in fact all of them are also quite capable of catching their animal prey on the wing, such as flying insects or small spiders from their webs. While exploring the flowers for their food, sunbirds generally hang on the flower itself or nearby, but may eventually hover before it with rapid wing-beats. It is the reverse with the humming-birds; a few of them are said to feed when sitting on the flowers, but the great majority take their food by hovering in front of them, introducing their long and thin bills inside the corollas and rapidly visiting flower after flower without alighting for a single moment.

Owing to the varied and often peculiar shape of the bill, several species of sunbirds and humming-birds have been considered as strictly adapted to feed, each of them, from one special kind of flower, the

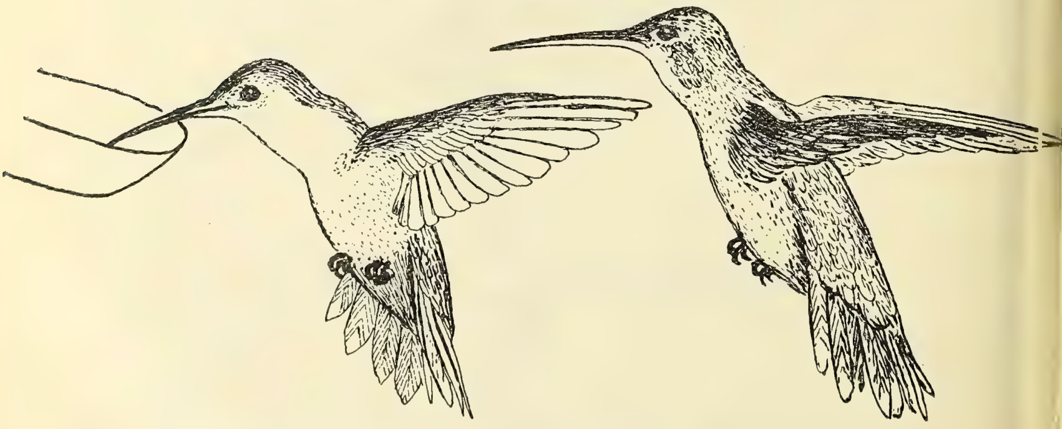


Fig. 4. Female Rubythroated Humming-birds in flight for drinking.

shape of which suits them best. As a matter of fact, from more recent and accurate observations, it seems that there are only very few cases of direct relationship between the species of plants and the species of birds visiting them, and mostly these visits remain only connected with seasonal changes or opportunities.

While the sunbirds are able to change their mode of flight variously according to circumstances, exactly as do other passerine birds, the more specialized humming-birds possess only one most peculiar way of flying, in close accordance with the peculiarities of the wing-structure and the shortness of the humerus, and from this they derive their popular name. It is a 'humming' flight consisting of uninterrupted, regular and very rapid wing-beats (up to 50 per second for the smallest species), which is rather similar to the flight of several types of moths (Sphingidae) and makes the latter easily confused with the birds in the countries where they occur side by side. On the other hand, humming-birds are the only birds which add to this peculiar, unique, mode of flight the ability of flying backwards quite as well as in any other direction. This singularity gives to them an unrivalled power of motion in the air, which contrasts strongly with the disability of their very short legs even to move on a branch.

If we now consider the biology of the reproduction cycle, it appears clearly that the two groups of birds diverge noticeably from each other. Sunbirds are seemingly, during the nesting season, mostly monogamous birds. The female is undoubtedly the only sex that occupies itself with the building of the nest and with incubation, but the male appears in most cases to take part in the feeding and rearing of the young and helping the female in the accomplishment of this duty. Male humming-birds on the other hand are polygamous. Both sexes live quite apart from each other, except for the act of mating, often even widely separated in space as well as season of the

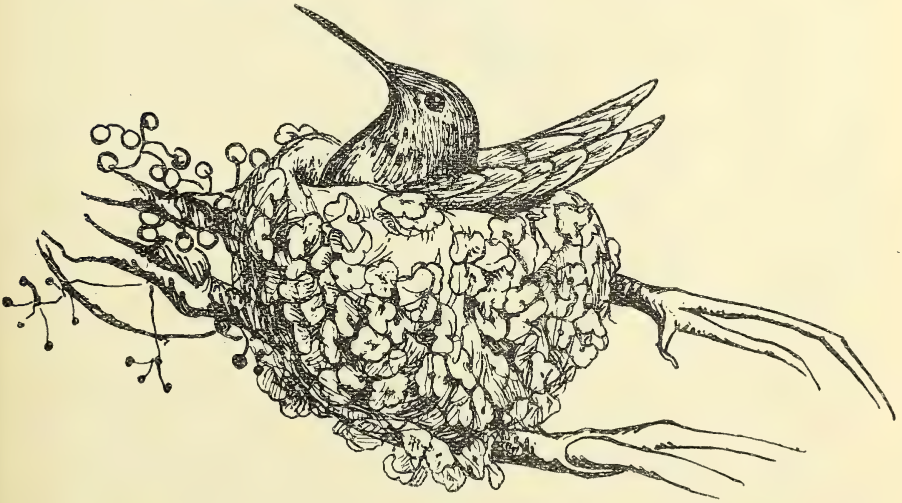


FIG. 5. Female Rufous Humming-bird sitting on nest.

year. In no case, as far as is known, does the male ever take the least part in the building of the nest or the rearing of the young, the female undertaking these very tiresome duties entirely by herself.

In both sunbirds and humming-birds the nests are most delicate and well worked-out structures, built chiefly with vegetal matter such as moss or very tiny twigs, associated with vegetable down and adhesive threads taken from spiders' webs. But the sunbirds always build closed, hanging, pear-shaped nests with a lateral entrance, mostly placed among bushes or tree-branches, often at the end of a branch. Humming-birds always build open, more or less cup-shaped nests, placed in most cases on branches or twigs, but often too on the most unexpected supports such as cave-walls or even human apparatus. In either group the normal clutch is composed of two eggs only, very seldom one or three. While the humming-birds invariably lay uniformly white eggs, somewhat elongate in shape and rather big compared to the size of the birds, the eggs of sunbirds exhibit the most handsome variety of colouring and pattern, being generally more or less adorned with dark frecklings or patches or stripes on a light ground of whitish, pinkish or bluish, and sometimes quite glossy.

Although the nests of the sunbirds are domed, with a rather narrow entrance, they are often parasitized, in Africa as well as in Asia, by several of the smaller species of cuckoos. Nothing similar of course occurs with the humming-birds, but we must not forget that in America the brood-parasitism of the cuckoos is far less developed than among their old-world cousins.

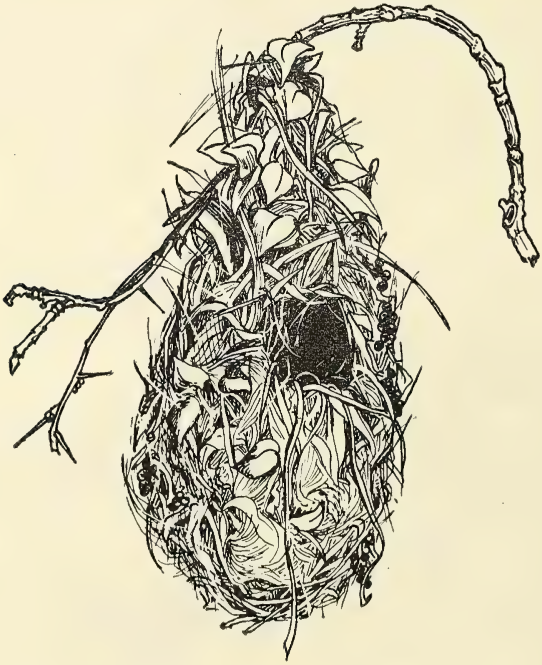


FIG. 6. Nest of an Indian Sunbird: *Cinnyris asiatica.*

## HABITAT AND GEOGRAPHICAL DISTRIBUTION

Sunbirds are to be found in all tropical and sub-tropical parts of the Old World, even in the deserts and on the high mountains. But, although some of them are able to accomplish a certain amount of changes in their habitat seasonally, none is known as a true migratory bird, and their travels never go beyond the limits of the warm areas where they can find flowers and insects all the year around. Many of them are quite sedentary and breed at any time of the year without a definite season.

Their northern limits of general distribution are Syria, the Himalayas and Southern China. They are especially numerous in tropical and southern Africa, but do not occur in north-western Africa. Not more than one-third of the species live in south-eastern Asia and the Malayan region, very few of them reaching even New Guinea and Australia. The Solomon Islands and Queensland are the most easterly limit of their geographical distribution.

In Africa, every kind of habitat generally possesses its own characteristic species of sunbirds: several of these are unknown except in the heavily forested, humid parts of the lowlands, as for example the magnificent *Cinnyris superbus* in West Africa. Some others, as for example *Nectarinia metallica* of the Sudan, are partial to very dry, sunny and even desert areas, where the flowering *Acacia* trees remain their favourite haunts and afford them most of their food. Others, as for example *Drepanorhynchus reichenowi* of East Africa, are strictly confined to high mountain slopes where frequent mist and rain entertain luxuriant vegetation. A certain number of species are however much more widely spread and may show, as does *Cinnyris cupreus*, much less partiality for any special kind of environment. In the drier districts the typical species very often exhibit a seasonal change in the plumage of the male ('eclipse'), which during the dry season appears more or less like the dull female. Such a change seemingly does not occur among the species living in more humid areas.

In India, the various species are mostly less specialised as regards their habitats and a few of them, for example *Cinnyris asiatica*, exhibit a similar seasonal change of the plumage as the African ones, but probably with much less regularity. In any case, all the sunbirds, whether in Africa or in Asia, are always rapidly attracted to gardens and the extension of the latter is generally followed by the spreading of the former, even into areas which from their natural conditions would seem rather unsuitable for the birds.

The humming-birds are a typically American group of birds, containing nearly twice as many different species as the sunbirds. But, owing to their strong power of flight and their speed, several species of North America are well-known to perform extensive and regular annual migrations, being found during the spring and early summer months as far north as Alaska and Labrador and wintering mostly in Mexico and Central America. To the south, humming-birds are spread all over the South American continent down to Tierra del Fuego, a few southern species also being migratory. They exist on most islands of the Neotropical Region: West Indies, Juan Fernandez, but not in the Galapagos. However, Central America and the Andean countries

(Columbia, Ecuador, Peru) are certainly the richest of all in numbers of species, and here they are encountered at all elevations.

Like the sunbirds, and perhaps still more, humming-birds may be found in every kind of biotope, from the most barren areas, where the flowers and even fruits of Cacti remain their chief, though precarious food resource, to the heaviest rain forest, becoming rapidly adapted to cultivated country as well. Several species live the whole year round in the high mountain ranges of the equatorial zone, close to the perpetual snow, amongst extremely poor life-conditions. Although some of them are obviously partial to very dry areas, seasonal changes of plumage—at least of regular occurrence—have not yet been definitely recorded for any species.

It may be added that these tiny birds, when living in close contact with human settlements, may become the tamest and most fearless birds in existence, to the extent of nesting inside freely opened and daily frequented rooms without the least apparent disturbance.

As a conclusion, it may be interesting to point out once more, from a general biological point of view, the close parallelism in the evolution of these two very different avian types—the humming-birds in America and the sunbirds in the Old World. But, from their morphological affinities, it must not be forgotten that the former constitute a highly specialized and differentiated group of birds, with well defined limits and no near allies. This is far from the case with the sunbirds, which are in fact closely allied to some other passerine types, especially the Honey-eaters (family Meliphagidae). In fact the frontier between Nectariniidae and Meliphagidae is rather unclearly defined, and the so-called 'Spider-hunters' (genus *Arachnothera* and allies) may be considered as a kind of connecting link between them.

# NEW PLANT RECORDS FOR SOUTH INDIA—I.

BY

D. Daniel Sundararaj
*Madras State Herbarium, Coimbatore*

(*With two plates*)

Since the publication of the Flora of the Presidency of Madras in 1935, a number of species not recorded in that publication have been noted in South India. C. E. C. Fischer, between 1932 to 1940 published a series 'New or little known plants from South India' in the Bulletin of Miscellaneous Information from Kew, in which he dealt with such species. For nearly fifteen years, there had been a gap in bringing such information up to date. It is proposed to deal in a fresh series, with all species not recorded so far in the Flora of Madras Presidency and also with those which are found in South India as recent introductions.

1. **Polygala glomerata** Lour. Fl. Coch. 426. 1790.

Bennett in Hooker's Flora of British India gives the distribution as 'Eastern Himalayas, hot valleys of Sikkim, alt. 1–6000 feet; Oude; Assam; Khasia Mts., alt. 0-5000 feet; Tenasserim; Eastern Archipelago, China'. This species has been collected also from Carcoor Ghats in Nilgiris at about 5,000 feet elevation by Lawson.

Stems densely pubescent; leaves variable, sessile or shortly petioled, broadly ovate or oblong to elliptic-lanceolate, secondary nerves obscure; flowers on short, extra-axillary racemes; outer sepals acuminate, sub-equal; wings hatchet-shaped, acuminate; crest very small, capsule narrowly winged, strongly ciliate; seeds large, silky-obovoid, strophiole 3–appendiculate, sinuses very narrow, curved.

Nilgiris: Carcoor Ghats—Lawson, Nov. 1885, Madr. Herb. No. 2381.

This specimen collected as early as 1885 by Lawson was not properly identified till recently.

2. **Ximensia encelioides** Cav. Icon. 2 : 60. 1793.

Syn. *Verbesina encelioides* Benth. & Hook. f. in Bot. Calif. 1 : 350.

A tropical American plant which has got introduced into India and recorded as occurring in the Upper Gangetic Plains (*Journ. Ind. Bot. Soc.* **15** : 156. 1936).

An annual herb, leaves deltoid—ovate, green and mainly pubescent above, pale and densely canescent beneath; flower heads peduncled showy; involucral bracts lanceolate; ray florets prominent, golden yellow; disc florets numerous, fertile; achenes obovate, flattened, winged scariously, pappus as two subulate awns.

Mysore: without locality etc. (1859)—Madr. Herb. No. 28265. Coimbatore District: Dharapuram, D. Daniel Sundararaj, May, 1946. Madr. Herb. No. 93135, Tiruchirappalli District: Karur - P. S. Jivanna Rao 23rd Sept. 1949. Madr. Herb. No. 93798.

A specimen from Mysore collected as early as 1895 without proper label as to the exact locality or name of collector had been identified and authenticated at Kew as *Guizotia abyssinica.* These two species, viz. *Guizotia abyssinica* and *Ximensia enceliodes*, have very close resemblances in the vegetative and head characters. The achenes in *Ximensia* have the characteristic wings and the pappus in the form of two subulate awns by which it differs. This comes up along the sandy banks of the Amaravathi river both in Dharapuram and Karur.

3. **Datura quercifolia** H.B. & K. Nov. Gen. Sp. 3 : 7. 1818.

Native of Mexico; recorded for India for the first time near the Southern extremity of the Peninsula.

Annual herb ; young parts pubescent; leaves long petioled, ovate, deeply sinuate or pinnatifid ; flowers small; calyx tubular prismatic quinquefid; corolla pale yellow tinged with violet, about double the length of calyx ; fruit an ellipsoid, spinescent 4-celled capsule with large unequal spines ; seeds thickish with a dark coloured and more or less pitted or rugose coat.

Tirunelveli District: Rajapathy—D. Daniel Sundararaj, 28th Dec. 1944, Madr. Herb. No. 87242 ; Vallioor—D. Daniel Sundararaj and J. Sakharama Rao, 14th May 1949, Mad. Herb. No. 93572.

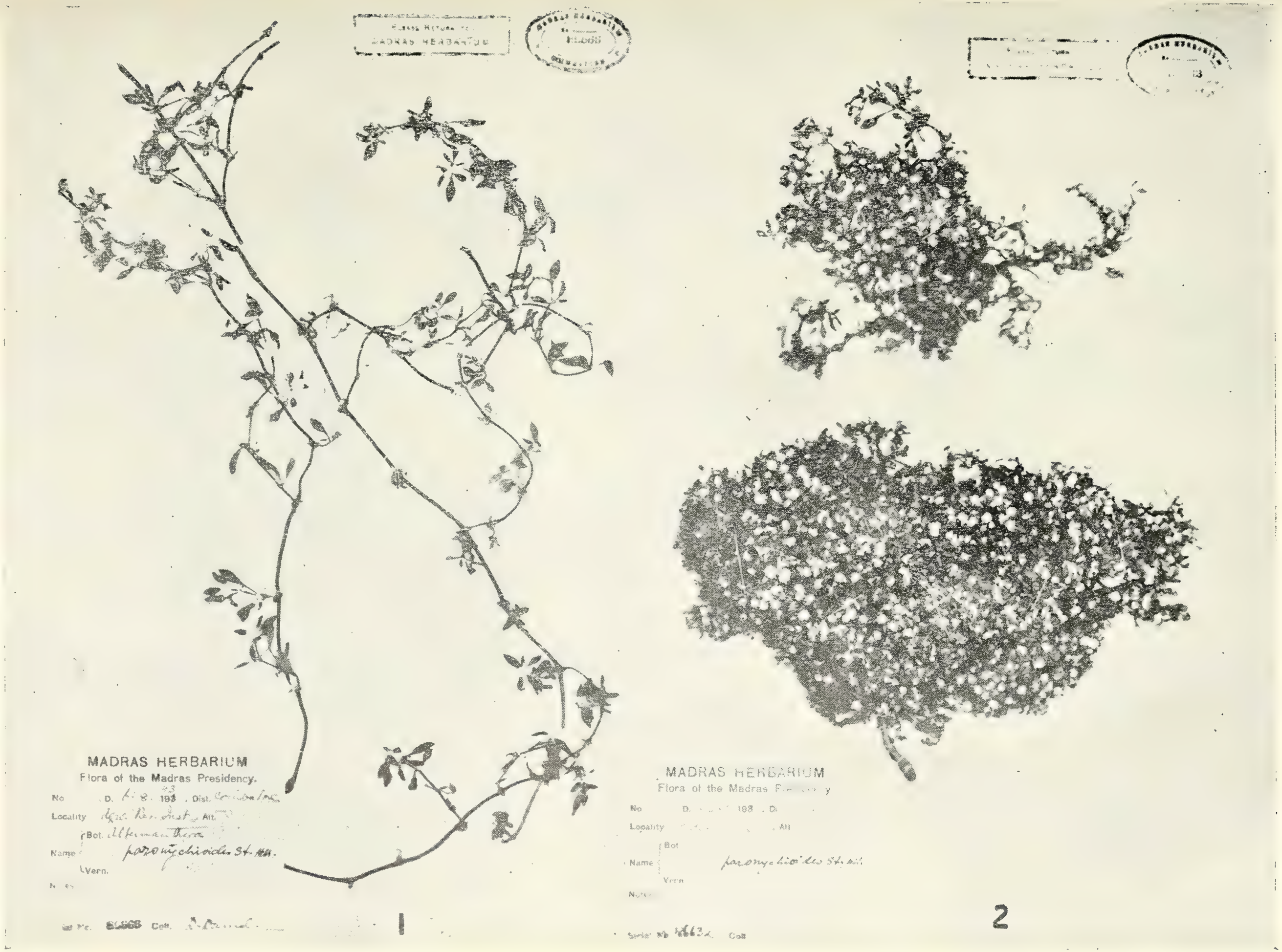
The plant has similarity to *D. stramonium* Linn. in the vegetative parts to a great extent and the flower size ; but the difference is chiefly in the few pinnatifid leaves and the comparatively big fruits with very prominent spines. The spines in *D. quercifolia* are very characteristic with broad base many of them extending nearly 2.5 cm. in length. The dehiscence of the capsule is regular, deeply valved approaching that of *D. stramonium.*

4. **Barleria vestita** T. Anders in Thwaites Enum. 230. 1860. et Journ. Linn. Soc. 9 : 492. 1867.

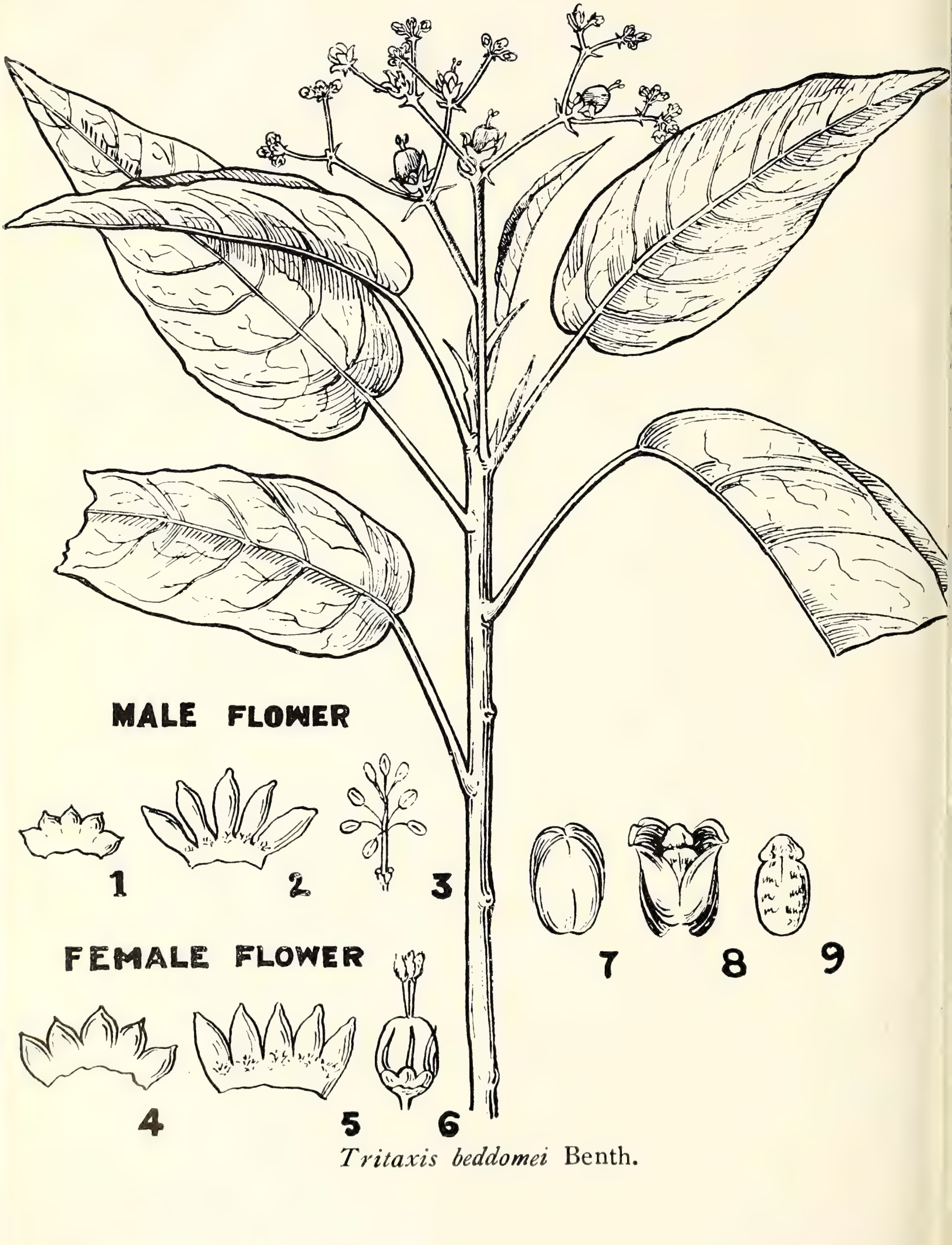
Trimen (1895) in the Flora of Ceylon treats this species as endemic to Ceylon. Clarke (1885) in Hooker's Flora of British India also gives only Ceylon, alt. 5000 feet, for its occurrence. But Beddome (1874) in his Ic. Pl. Ind. Or. has recorded this plant as occurring in 'Ceylon, C.P., and Saffragram district'. A specimen collected by Beddome himself in 1873 bears the labelling 'Neelgheery Hill, 1873'. This is the exact specimen from which he made the drawing t. 263 in the Icones ; but it is baffling how he did not mention Nilgiris in the distribution. Gamble who had access to this Beddome's sheet while writing up the Flora of Madras Presidency did not include this in the Flora. He has left a small note on the specimen which is as follows : 'This is, I have no doubt, the very specimen from which Beddome's Ic. t. 263 was drawn. But he describes it from Ceylon and so the entry Neelgheery Hill is clearly a mistake. Trimen gives it as an endemic Ceylon Sp. 18–5–1923.'

However, there is another specimen of *B. vestita* in the Madras Herbarium ; this had been collected by Lawson (1883) from 'Kartaery-Nilgiris'. The locality is nearly 5500 feet in elevation and the fact that the species has been collected on Nilgiris is sufficient proof that the species occurs also in South India.

Herbaceous, hirsute, young shoots patently yellowish brown hairy ; nodes constricted and internodes swollen ; leaves ovate-elliptic up to 20·5 cm. long, attenuate at both ends, short-petiolate, petiole and the mid-


MADRAS HERBARIUM
Flora of the Madras Presidency.
1
MADRAS HERBARIUM
2

*Alternanthera paronychioides* St. Hil.


MALE FLOWER
1
2
3
FEMALE FLOWER
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8
9

*Tritaxis beddomei* Benth.

rib very hairy; flowers in cymes on long peduncles, but shorter than the leaves, axillary or terminal; bracts conspicuous linear-lanceolate; calyx fulvous strigose, unequal, lanceolate; corolla white or pale purple, 7·5 cm. long, fruit ovoid or oblong capsule.

Nilgiris: Neelgheery Hill—R. H. Beddome, 1873. Madr. Herb. No. 38605: Kartaery, M. A. Lawson, Aug. 1883. Madr. Herb. No. 38606.

5. **Alternanthera paronychioides** St. Hil. Voy. Brés. II 2: 439. 1833.

Syn: *Achyranthes polygonoides* (Linn.) Lam. Encl. 1: 547. 1785. *Alternanthera polygonoides* R. Br. Prodr. 417, 1810. A native of tropical America. Reported first in India by Raizada as occurring on the banks of the Ganges in Cawnpore and Benares (*J. Ind. Bot. Soc.* 15: 149–167).

A prostrate spreading perennial herb, rooting at the nodes and densely white villous in young parts; leaves opposite, spathulate, elliptic; flowers in dense sessile glomerate heads, white bracts and bracteoles half as long as the perianth lobes, mucronate, perianth lobes 5, oblong-lanceolate; stamens 5, filaments united at the base in a short tube, short staminodes present; ovary 1-celled, 1-ovuled, style very short; utricle orbicular, included in the perianth; seed orbicular, 1 mm. broad, dark brown shining.

Coimbatore District: Coimbatore town, D. Daniel Sundararaj, 28th July 1943, Madr. Herb. No. 86632. 6th August 1943. Madr. Herb. No. 86666.

This herb with much variation in growth form is commonly found along the damp sides of drainage channels in Coimbatore town. This species has not been noted anywhere else in South India so far. The free growing plants have long internodes with leaves and inflorescences arranged lax on the stem; but the plants growing in areas often trampled by men or animals have much congested stems with all the plant parts giving a clumpy appearance. Such plants have also much white hairiness (vide Fig. 1 & 2, Plate I).

6. **Tritaxis beddomei** Benth. *emend.* D. Sundararaj.

This is an endemic species found in Tirunelvelly District of Madras State. Bentham described the species from a specimen collected from 'Tirunelveli; East India Penninsula'. Hooker (1887), in Flora of British India, had doubts even about the genus of this species described by Bentham, as the specimen had 'no female flower in the male cyme' and 'the fruits unknown'. Brandis (1906) in Indian Trees had similar doubts. Gamble, while accepting the inclusion of this species in the genus *Tritaxis*, is not definite as to the habit of the plant which he described as 'a tree' in his Manual of Indian Timbers and as 'a small tree' in the Flora of the Presidency of Madras. A detailed improved description of this species including that of the female flower and the fruits, not seen and described so far, is given below:

Small shrub, 80 to 120 cm. in height, shoots glabrous, shining with pale papery bark; leaves alternate, entire, broadly lanceolate to ovate, base cordate, apex acute or obtuse, mucronate; petioles 2.5 to 7.5 cm. long, stipules minute, caducous; inflorescence terminal or axillary dichotomously branched cymes with solitary short pedicelled female flowers at the forks; flowers unisexual, monoecious, bracteate; male flowers 0.4 to 0.5 cm. long, 0.3 to 0.4 cm. broad ; calyx less than half the length of the corolla with 5 sub-imbricate lobes, connate at the base; corolla lobes 5, oblong, hairy within about the base of the lobes; disc glands 5, prominent, reddish ; stamens 8 of two whorls, outer 5 and inner 3 forming a central column, anthers oblong; female flowers 0.6 to 0.8 cm. long, 0.5 to 0.6 cm. broad ; calyx bigger than that of the male; corolla pale yellow ; disc glands 5, oblique ; capsule of 3, 2-valved cocci; seeds oblong crustaceous, mottled, shining, caruncle prominent, albumen fleshy, cotyledons broad and thin.

[**Tritaxis beddomei** Benth. *emend.* D. Sundararaj.

*Frutex* parvus, 80–120 cm. altus, ramis glabris, nitentibus, cortice pallido papyraceo. *Folia* alterna, integra, late lanceolata vel ovata, ad basim cordata, ad apicem acuta vel obtusa et mucronata; petioli 2.5–7.5 cm. longi, stipulis minutis, deciduis. *Inflorescentia* cymosa, terminalis vel axillaris, dichotome ramosa, uno flore femineo ad singulas bifurcationes posito; flores unisexuales, monoecii, bracteati. *Flores masculini* 0.4-0.5 × 0.3–0.4 cm. *Calyx* quam corolla duplo minor, lobis subimbricatis 5 ornatus, ad basim connatis. *Corollae* laciniae 5, oblongae, intus pilosae ad basim. *Disci* glandulae quinae, eminentes, rubescentes. *Stamina* 8, bisseriata, quorum 5 exteriora, 3 vero interiora, columnam efformantia; antherae oblongae. *Flores feminei* 0.6–0.8 × 0.5–0.6 cm. *Calyx* maior quam in flore masculino. *Corolla* pallide lutea. *Glandulae* disci quinae, obliquae. *Ovarium* 3-loculatum, stylo triplici, stigmatibus bifidis obliquis ornatum. *Capsula* constans coccis tribus bivalvulatis; *semina* oblonga, crustacea, marmorata, carunculo prominenti, endospermo carnoso, cotyledonibus latis et tenuibus.]

Tirunelveli District—Near Vijayapathy, D. Daniel Sundararaj and S. R. Raju, 5th Feb. 1945, Madr. Herb. Nos. 87314, 88126; D. Daniel Sundararaj and J. Sakharama Rao, May 1949, Madr. Herb. No. 96729.

This species occurs at the foot of the Western Ghats on the Eastern slopes in sandy areas round about Panagudy, Radhapuram and Vijayapathi. Local name (Tamil) ' Aathaḷai '.

Baillon (1858–Etud. Gen. Euph. 342) who originally founded the genus *Tritaxis* on the Cochin-Chinese type *T. gaudichaudi* Baill. pointed out the affinity of the genus to *Jatropha* ; but later reduced it to *Trignostemon* in his Histoire des Plantes. Bentham (loc. cit.) was of the opinion that *Tritaxis* should form a separate genus and observed it to be nearer to either *Ostodes* or *Jatropha*. Our close study of the species *T. beddomei* Benth. points out its close nearness to *Jatropha*, especially from the inflorescence and flower characters.

## ACKNOWLEDGMENT

The author is indebted to Rev. Fr. A. Rapinat, S.J., for the rendering of the English description of *Tritaxis beddomei* into Latin.

# THE LION CENSUS OF 1955

BY

M. A. Wynter-Blyth

*(With a map)*

## I. 1950–1955.

At the moment of writing the policy of the Saurashtra Government is to grant no permits for the shooting of lions. Whether or not this is wise is doubtful. At worst it is a fault in the right direction.

During the last six years, with the exception of two periods, very few lions have either been shot on permit or poached. The result, as shown by the 1955 census, has been a large increase in the number of lions.

Readers of the article on my first lion census in Volume 49(3) of the Society's *Journal* may remember that a pride of fourteen lions was then counted near the Hill of Sana. These lions continued to remain outside the forest and moved in a northerly direction, spreading, if one is to believe the garbled accounts in the local press, alarm and despondency among the inhabitants who were unaccustomed to seeing lions in such large numbers. There were tales of damage done to local stock, which were probably correct, and tales of unprovoked attack on human beings, which were certainly quite untrue. The net result was that permits to shoot these animals were granted, and five or six of them, some mere cubs, were killed.

Since this unfortunate incident not more than a further five or six lions have been shot on permit, but a small number has been trapped by the forest department.

In 1952, as alarming reports again appeared in the press—this time of a wholesale slaughter of lions in the Sasan neighbourhood, I was asked to hold an enquiry and to report on what had happened. In all there turned out to be ten cases to investigate.

Firstly, three dead lions had been found and two wounded lionesses destroyed between August 22 and September 22, all on the western edge of the Sasan Division of the forest, and all within a limited area, the northernmost case (at Mendarda) being but 12 miles from the southernmost (at Dharampur). Descriptions of the wounds found on these animals were consistent with gunshot wounds. As a number of villagers had recently been issued with guns as members of the home guard it seems more than probable that these persons had shot at the lions, either in protection of their flocks and herds or to scare them away before they could do any damage.

There were no more cases in this area after the police began to investigate.

The case of one of the wounded lionesses is worth recording. At Sandbera Nes, some six miles from Sasan, early on the morning of September 16 a maldhari of the nes drove out his buffaloes from the thorn enclosure surrounding his hut, leaving open the exit. Shortly afterwards a badly injured lioness limped in and settled herself down in a corner of the nes, outside a long room in which were still penned-up seven goats. This room was divided into two by a six and a half foot partition, the goats being in that half of the room further from the lioness and the entrance.

Although the inhabitants of the nes tried to drive away the lioness by shouting and throwing stones at her, she refused to stir but, later, when the sun got up, needing shade, she moved into the empty half of the room, shortly afterwards leaping over the partition to kill six of the goats, but to eat none of them. The seventh goat forced its way to safety through the flimsy wall of the hut.

By this time a forest guard had gone off to Sasan to report to the Divisional Forest Officer. He was instructed to return and to destroy the lioness, which he did by climbing on to the roof of the hut and firing at her from above.

She was found to have been suffering from extensive gunshot wounds in the head, shoulders, and one paw. In addition a porcupine quill was sticking into her chest. In her weakened state hunger must have compelled her to attack this singularly unpalatable creature.

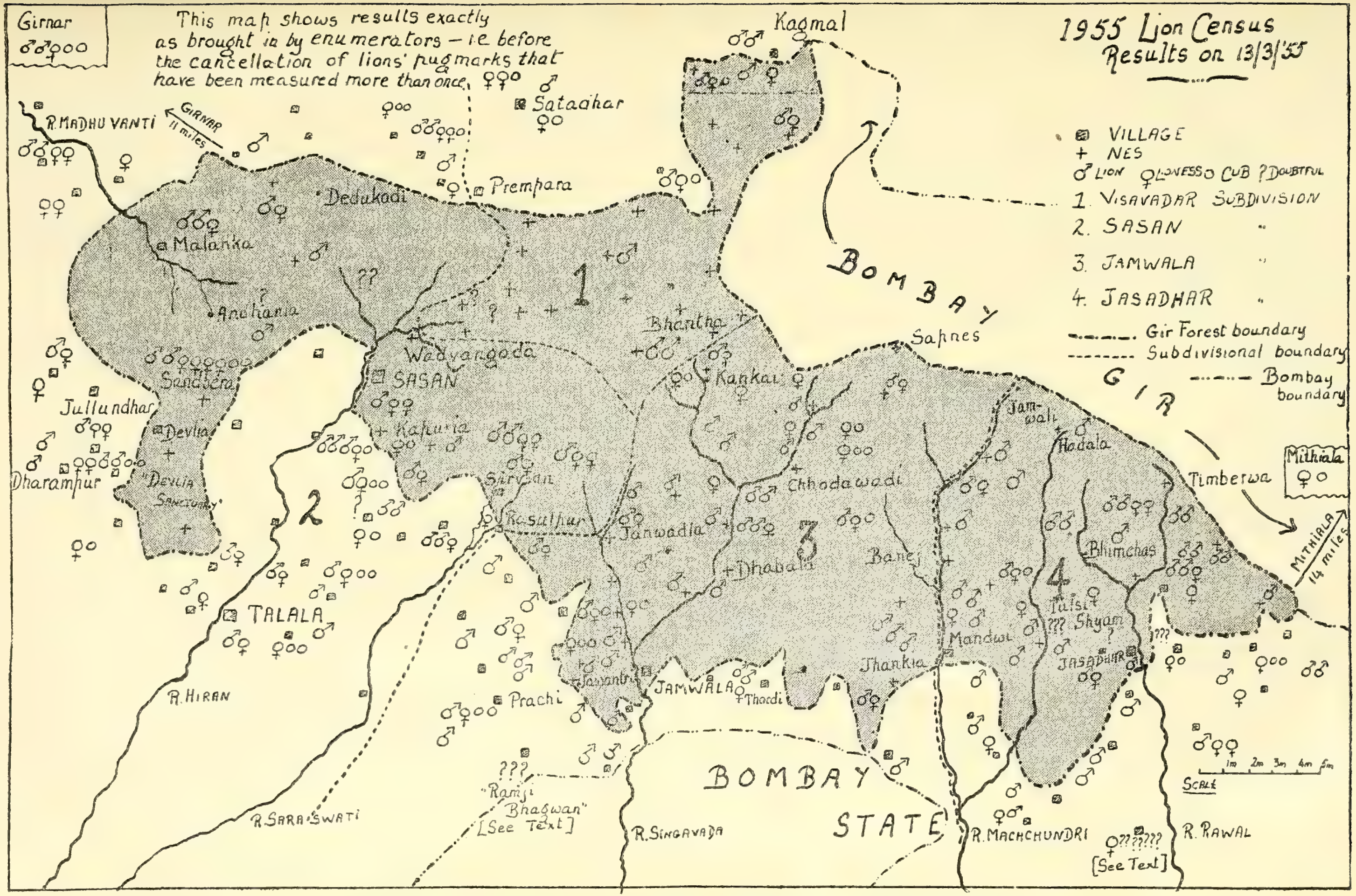
Of the remaining five cases, one was that of a lion shot by a maldhari in the Girnar Forests because it was harassing his cattle, for which he was punished. Two were mere collections of bones and skin found in the deep jungle, and there is no reason to think that they could not have died in the natural course of events. The remaining two had been shot in the Baroda Gir—one lion on permit, and the lioness at the same time 'because she attacked', an unlikely story unless she too had been wounded.

This visit also enabled me to travel round most of the forest, and in particular to tour the Visavadar Range, an area which I had never been to before. During this trip I cannot remember visiting any nes or village where lions had not been seen or otherwise recorded somewhere close by within the previous forty-eight hours, and in my report I was able to state that it was my general impression that lions were on the increase.

Regarding the other game in the forest I gained a very different impression, for I saw very little and the only areas where it was at all abundant were close to Sasan (where wild pigs were then in great abundance) and near Janwadla. I continued to have an impression of a progressive decrease in forest game during my frequent visits to the Gir between 1952 and 1954 until my stay at Sasan in February 1955 when I went there to plan out the census. On this occasion I saw more forest game than I had ever seen before. During the census in March 1955 and on a recent visit to the forest I have seen game in plenty, and am now of the opinion that it has increased over the last year or so and is increasing.

## II. The Census, April 11 to 14, 1955

The census of 1950 had been such an arduous and difficult operation that I had vowed that I should never again undertake a full-scale census, and so when I was asked to hold one in 1955 I strongly represented that a partial census of the central area of Jamwala, which could be made very accurate, would serve the purpose. This did not meet with approval and once more I was persuaded to undertake a census of the whole Saurashtra area. That this went so smoothly and was so easy to carry out, in spite of my gloomy prognostications, was of course largely due to the excellent


1955 Lion Census
Results on 13/3/55
This map shows results exactly as brought in by enumerators – i.e. before the cancellation of lions' pugmarks that have been measured more than once.
VILLAGE
+ NES
♂ LION ♀ LIONESS o CUB ? DOUBTFUL
1. VISAVADAR SUBDIVISION
2. SASAN "
3. JAMWALA "
4. JASADHAR "
Gir Forest boundary
Subdivisional boundary
Bombay boundary
Girnar
GIRNAR 11 miles
R. MADHU VANTI
Satadhar
Prempara
Kagmal
Dedukadi
Malanka
Anchania
Sandera
Jullundhar
Devlia
Dharamphur
"Devlia Sanctuary"
Wadvangoda
SASAN
Kaduria
Sirvan
Rasulpur
Bhantha
Kankai
Janwadia
Chhodawadi
Dhabala
Banej
Jamwali
Hadala
Bhimchas
Tulsi Shyam
Mandwi
Thankia
JASADHAR
JAMWALA
Thordi
Jasvantri
Prachi
TALALA
R. HIRAN
R. SARASWATI
"Ramji Bhagwan" [See Text]
R. SINGAVADA
R. MACHCHUNDRI
R. RAWAL
[See Text]
BOMBAY
Sapnes
GIR
Timberwa
Mithiala
MITHIALA 14 miles
BOMBAY STATE
1
2
3
4
SCALE 1m 2m 3m 4m 5m

Sketch map showing enumeration of Lions in Saurashtra 1955

help I had from my assistants and to the experience gained from the first census, but above all to the fact that the Chief Minister was especially interested in the matter with the result that I had every possible facility and cooperation.

Below are given the results of this census together with the figures of the 1950 census for comparison.

| AREA | LIONS | LIONESSES | YOUNG (Say under 18 months) | TOTAL | 1950 |
|---|---|---|---|---|---|
| Sasan Range ... | 52 | 43 | 19 | 114 | 68 |
| Visavadar Range ... | 11 | 9 | 4 | 24 | 24 |
| Jamwala Range ... | 42 | 24 | 14 | 80 | 45 |
| Jasadhar Range ... | 34 | 22 | 9 | 65 | 45 |
| Mithiala ... | ... | 1 | 1 | 2 | 1 |
| Girnar ... | 2 | 1 | 2 | 5 | 3 |
| Other Areas ... | ... | ... | ... | ... | 14 |
| Baroda Gir ... | not included in this census | | | | 24 |
| Totals ... | 141 | 100 | 49 | 290 | 224 |

*Notes on the above*

SASAN RANGE includes the old Sasan forest division, a large strip of Visavadar Mahal to the north, the Jetpur Forest and the Devalia Sanctuary with a strip of revenue land to their east, the revenue lands between the Devalia Sanctuary and the Sasan forest, and the revenue lands around Talala and to the east and west of it.

VISAVADAR RANGE, JAMWALA RANGE, JASADHAR RANGE includes the revenue lands bordering these ranges.

*Figures for the Jamwala Range 1950*: These are misleading as for three days previous to the census a very large fire had swept much of the range, driving game and lions out of it. Therefore these figures are lower than would normally be expected. In the test count of a mere 2/3rds of the range 42 lions were recorded.

MITHIALA, GIRNAR. These two areas are situated at some distance from the Gir Forest. Lions are nowadays permanent inhabitants of both areas.

These figures show that there has been a substantial increase in the lion population since 1950. An important point to note is that on this present occasion it was possible to include in the census certain areas outside the forest that were beyond the scope of the 1950 census. These produced 40 lions, making the comparative figures for the areas covered *in both censuses* 250 to 200, that is an increase of 25 per cent.

We may then conclude that an all-round increase of 25 per cent is not far from the truth.

Young Lions: Any lion with a pugmark of 4·5″ or less in length is considered to be a young lion, i.e., not more than 18 months old.

The proportion of young lions has decreased from 19 per cent in 1950 to 16.9 per cent in 1955. The latter, if my arithmetic is correct, is the number of young lions to be expected in a stationary population with an average life span of just under 9 years. Unfortunately information on the length of life of lions in their wild state is most unsatisfactory, varying from the 10 years of one 'expert' to the 30 years of another! As the average age of a lion seems likely to be more than 9 years the number of young lions probably still indicates an increasing population, though one that may be increasing more slowly than five years ago. It should also be remembered that very young cubs will not usually enter the census. I do not think the decrease in the number of young lions is yet in any way serious.

Proportion of Lions to Lionesses: It is difficult to say to what extent these figures are accurate, as the method of determining sex by the shape of the pugmark is far from infallible, as was made obvious to us when we came across instances of the same lion being recorded as a male in one place and as a female in another.

Nevertheless old Junagadh records of the sex of lions shot and found dead, and every census have shown a large preponderance of lions as may be seen from the following figures :

1936 to 1947: Lions shot or found dead in Junagadh Gir: Lions 45 ; lionesses 28.
1936 Census: Lions 143; lionesses 91.
1950 Jamwala Test Count: Lions 23; lionesses 13.
1950 Census (determination of sex only made in Baroda Gir and Jasadhar Division): Lions 42 ; lionesses 19.
1955 Census: Lions 141; lionesses 100.

Notwithstanding these records almost everyone insists that the reverse is the case and that there are more lionesses than lions. I respectfully suggest to these gentlemen that their belief in the preponderance of lionesses is due to the fact that all young lions, being maneless, look like lionesses from a distance.

Distribution of Lions: As was expected the greatest concentrations of lions were found on, or outside, the forest edges near revenue villages. The most heavily populated regions were near Talala, and on the forest borders of the Jawantri and Janwadla centres of Jamwala. With the exception of the Chhodawadi centre of Jamwala, and Jasadhar, the middle forest regions contained many fewer lions.

As at the last census, the Jasadhar Range showed itself to be the home of big lions, for there four pug lengths of over seven inches were recorded. The only other lion of such pug measurements was found near Sasan.

## CENSUS METHODS

As there have been so many queries as to how the census was carried out and as so many mistaken ideas about it are current, it will perhaps not be out of place to recapitulate the census methods.

I possess no form of magic by which I can prove the accuracy of my censuses, nor do I pretend to be able to find exact numbers of lions—only the simple can expect that—but I myself believe that the final figures are not far removed from the truth and, as I have been extremely cautious in my count, I should be very much surprised if there are less lions than the figures I have given.

However, what cannot be stressed too strongly, and what it is very difficult to make people realise is that the main object of the census is to find out the increase or decrease in the numbers of lions, since to know this trend is vital to any policy of protection—much more important than to know the exact number of lions.

If censuses are carried out at regular intervals *and if exactly the same methods are used* they will produce this information admirably. The 1950 and 1955 censuses were carried out in an identical manner and therefore one may be confident that the comparative figures are reasonably accurate.

The census is based on three main factors. Firstly, as the measurements of the full length and breadth of the front pugmarks are seldom identical in any two lions, such data can be used for identifying individual lions in much the same way as fingerprints are used by the police for identifying criminals. Secondly, lions move about a lot at night, and for preference move along roads and footpaths (the silence and ease with which they can do so being of value to them while hunting). Thirdly, from December to June these roads and footpaths are covered with a particularly fine dust, which is a perfect medium for recording pugmarks exactly. Therefore, if a large number of enumerators is sent out over a network of beats to cover the areas inhabited by lions, the majority of their tracks will be found and their footprints measured. Even if lions do not walk along footpaths or roads, they are likely to cross them and so enter into the census.

Another count is then held with the object of recording most of those lions which have, for one reason or another, escaped the first day's count.

For the purpose of the census the areas inhabited by lions are divided into two divisions, namely Sasan and Jamwala. The former is also subdivided into the Sasan and Visavadar areas, and the latter into Jamwala and Jasadhar. Mithiala and Girnar are well separated from the Gir Forest and the number of lions recorded there is based on information received from the forest staff and not on a count. Every area where lions may be expected to be found is thus covered.

The subdivisions are further divided into a number of centres, each under the control of a supervisor whose duty it is to brief and control the enumerators. The enumerators work in pairs, and as far as possible an experienced man such as a beat guard is coupled with one less experienced.

The measurements, which are made with thin bamboo strips which can be broken to an exact length, are first handed in to the supervisors, who label them with all relevant information and then take them to subdivisional headquarters from whence they are passed on to Sasan or Jamwala, where the information is entered on to a series of maps.

From these maps lions which have been counted more than once are noted and only one lion counted in each such instance. For this purpose, of course, a certain variation in measurements is allowed, but the principle employed is that if there is any suspicion at all that a lion has been counted more than once only one lion is counted finally. All suspicious measurements are also eliminated. For instance any lone ' lions ' with pug lengths of less than 4·5″ are crossed out, as young lions of this age will in all probability still be accompanied by their mothers. Such measurements are usually those of panthers taken by mistake. Other checks on measurements are the ratio between the length and breadth of pugmarks (which should work out at between 1·1 and 1·3) and the number of lions moving together.

### A Popular Fallacy regarding the Lion Census

A criticism made by several people is that the census, to be successful, must be held in the hot weather, that is in May, on the assumption that drinking places are then fewer, and under the misapprehension that the census is based on counting pugmarks—or the lions themselves—at such places.

If the drinking places in the Gir were very limited in number all that would be necessary would be to keep a watch on them and measure the pugmarks of the lions that come to drink, for lions will obviously drink at least once in the twenty-four hours. But this is far from the case as the Gir possesses a number of perennially flowing rivers along any part of which a lion may drink. Furthermore, as the edges of the rivers are nearly always of rock, grass or coarse sand or shingle, they are almost always unsuited to the measurement of pugmarks. Lions may also drink from village water troughs, as I myself have seen. Drinking places, then, play a very minor part in the census.

Another argument for holding the census in the hot weather is that lions then will move about less. The latter is probably true but the more lions move about the more chance of recording their pugmarks.

## III. Conclusions

Although the census figures show that the rigorous control over the shooting of lions in recent years has been most successful, this increase in numbers brings problems in its wake.

The Gir Forest obviously can only hold a certain number of lions, and once this is exceeded one may expect a progressive decrease in the numbers of forest game and a corresponding increase in the losses of domestic stock up to a point at which they cannot be endured.

At the moment the forest game does not seem to be decreasing, and one concludes from this that these animals must therefore form a small proportion of the lions' food, the greater amount of what they eat being domestic stock.

From random figures taken five years ago I estimated the annual loss of cattle and buffaloes in the nesses and forest villages, and villages at the forest edges, to be in the neighbourhood of 3% of the total stock—and the total stock is very large indeed. Government has also gone into this matter recently and has, I believe, reached conclusions similar to mine.

Evidence in support of domestic stock forming the greater part of what the lions eat is that lions are nearly always found prowling in the neighbourhood of villages and nesses, and it is near such places that the vast majority of them is recorded in the censuses. (See map.)

So far the maldhari has, on the whole, been fatalistic about these losses and seems to regard them as part of the terms upon which he gets good cheap grazing. However, any considerable increase in them will undoubtedly be viewed in a different light.

I feel then that the time has come to grant, say, five or six permits per annum for shooting lions, as an experimental measure, and to hold check counts, perhaps annually. The subsequent issue of permits can be regulated in accordance with the results of these, or of full scale censuses which may be held when considered necessary.

I would suggest that the check censuses be held in the Jamwala subdivision, where this matter has been most studied and where there are a number of men trained in census work. Such check censuses would be easy to carry out, cheap, and would soon become routine.

## IV. Census Experiences

The management of the Sasan Division was in the hands of the Yuvraj of Jasdan and K. S. Lavkumar of Jasdan than which two expert naturalists I could not have had better helpers for this census work. As in 1950 I myself took the Jamwala Division, on this occasion helped by the brothers Dost and Nur Mahomed, both great 'characters' and persons of much ability.

The whole party foregathered at the Sasan Rest House on arrival, and the following morning made a visit to Devalia, the scene of recent attempts to catch lions. One lioness had already been caught, and others were caught later.

The method is simple. A wooden cage with iron bars at the sides is placed by the road with a goat tied up in it at the end further from the entrance. The lion attracted by the bleating of the goat enters the cage and in doing so presses down a board which causes the entrance door to drop behind him and another gate to fall between him and the goat, thus saving the goat! Nevertheless there were remains of dead goat in the second partition and, as the cage was only six feet long, one imagines that the lion in his first rush receives the second gate on his neck whilst the entrance door guillotines his tail.

A good story had already grown up about the captured lioness. As she was being carried to Junagadh by night the lorry that was transporting her broke down. The furious roaring of the lioness from the stranded lorry attracted all the lions in the neighbourhood to see what was amiss with her, with the result that the lorry driver and his mate spent a night of terror in their cabin with more than twelve lions prowling around them trying to get to the lioness.

As our plans had been drawn up and all arrangements made during a previous visit to the Gir in February, our duty now was mainly to travel all over our divisions to see that these arrangements were being carried out. The important thing was to visit every centre and there check the work of at least one or two enumerators in the field—in short to give the impression we were taking the census seriously and expected everyone else to do so. This was hard work as it meant travelling many miles in an open jeep in the blazing sun of a March heat wave. There were few parts of our division we did not visit; the narrow valley of Jamwali where thousands of acres had recently been devastated by a forest fire; Bhimchas, where Bhim, being refused water, split the rock with a blow into a deep gorge through which the river flows in a channel that legend says is bottomless; the barren lonely wastes of the Hadala and Timberwa uplands where one gets the impression of having reached the uttermost parts of the world; a night spent in the open in the forest compound of Jasadhar surrounded by its babul jungle; once more a taste of the famous hospitality of Lord Krishna's priests at Tulshi Shyam; innumerable cups of tea wherever we paused, from Rabaris, forest guards, pasaytas and others; and lastly a large part of a day spent most peacefully under a pipal tree in Thordi drinking curds and eating chapatis when our jeep broke down.

On the first day of the census enumerators walk over their beats to get to know them and to mark any lions' pugmarks that are there already so that they shall not count them on the first day of the census, though the chance of this is small as by day at this season a strong sea breeze arises which soon makes fresh pugmarks look old. It is on the second and third days that the count is made.

On the second day of the census we made our trip to Jasadhar, leaving the following evening so that we could collect both days' measuring sticks, and then deal with those of both days from the Jamwala subdivision when we returned there in the evening.

During our stay at Jasadhar an amusing incident occurred. A pasayta (for pasaytas, being government servants, had been recruited for the good work) brought in his little bundle of measuring sticks from his village and the neighbourhood round about—an obviously simple straightforward type with no guile about him (though I must qualify this by saying that I know it is dangerous to make statements like this in Saurashtra). The bundle of sticks measured as follows: 6·7″ × 5·2″ : 6·7″ × 4·9″ : 2·2″ × 1·8″ : 2·2″ × 1·8″ : 2.2″ × 1·7″ : 2·3 × 1·7″ : 2·2″ × 2·2″: 2·2 × 1·7″. This intriguing collection of measurements was meant by him to represent two lionesses with three cubs apiece (as they were all found in the same place), obviously a very simple and just division of the pugmarks he had measured. However, as the length of the first two measurements was the same and the ratio between the second measurements was too high, there was more than a strong suspicion that the front and the hind feet of the same animal had been measured. This left in our minds the delightful picture of a large (very large) lioness wandering about the outskirts of the pasayta's village accompanied by her six little (very little) cubs. This would have just been possible had not the footprints of the 'cubs' been smaller than cubs' footprints could have been even at birth. No! we regretfully decided that the cubs were one village cat wandering around in circles confusing its own tracks.

Pasaytas (and it is perhaps necessary to explain to the uninformed that a pasayta is a village policeman) certainly provided the census with light relief, for when we returned to Jamwala we found another bunch of measuring sticks sent in by the pasayata of a village not far away, the measurements of which were those of long thin footprints, something I imagine like those of young Abominable Snowmen. However, as we were not on this occasion taking a census of Abominable Snowmen in the Gir Forest these measurements did not enter into the count, and we made an immediate visit to the pasayta's village, where we found his wife but not himself—he had had an urgent call to a distant sick relative. As the pasayta's name was Ramji Bhagwan, we decided that he had considered himself fully capable of conducting his census work *in absentia* from some distant Kailas.

When we had finished at Jamwala we had had neither sight nor sound of lions. Those at Sasan had been more fortunate (except for one member of the party who, walking in the jungle, had found himself in the centre of a large pride) for by the use of baits they had had several enjoyable evenings attempting to photograph another pride at Sandbera.

It was to Sandbera Nes then that we went on the evening of our return to Sasan. The pride had not killed the previous night, which meant either that they had moved elsewhere or that they would be hungry.

Close to the nes there is a fine flat maidan with one large tree in its middle. There is no more suitable place in the whole of the Gir Forest for watching lions than this if plans work out well.

Just after dusk we tied up a young buffalo to this tree but even whilst this was being done a lion emerged from the shadows so that those who were tying it up had to fly almost before they had finished. The lion was on to the young buffalo in a moment and had killed it, but as we were still unprepared and the lights of our jeeps were not focussed on the buffalo we could not see how he did it, but it was to the accompaniment of much noise.

As soon as we had got into our jeeps and moved towards the kill we saw that the lion had the buffalo by the throat and was apparently drinking his blood. We proceeded until we were within thirty-five yards but the lion took no notice of us at all. Nor did he at any moment of the subsequent two and a half hours that we watched him and his followers, although he was constantly in the full glare of our headlights.

What followed was a practical lesson in natural history such as few people have been privileged to witness. We had ringside seats, as it were, at a dinner party of one of the rarest animals in the world.

As we moved forward our headlights were reflected from four pairs of eyes watching from the forest bordering the maidan. These belonged to the rest of the pride. One of these animals moved forward towards the kill to reveal herself to be a large lioness, but she remained at a respectful distance from it and made no attempt to join the lion at his meal. He was obviously a gentleman of character as it was not until he had finished that she was allowed to begin her dinner. Having torn out the entrails and eaten much of them, the lion bit off and devoured large, whole chunks of meat with tremendous voracity, but presently his tempo of eating slowed down as his stomach grew visibly more and more distended, until at last he confined himself to licking one or two succulent parts of what was left of the buffalo. Finally, replete, he moved a yard or so away and began to clean himself, for his mane and chest were drenched in blood. How apt is the simile in the Odyssey likening Odysseus after his battle with the suitors to a lion 'spattered with blood and filth when he comes from feeding on some farmer's bullock, with the blood dripping from his breast and jaws on either side, a fearsome spectacle.'

The lioness now moved in to begin her meal, and a younger lioness also appeared from the shadows and began to share with the older female. The lion in the meanwhile, having decided that cleanliness could wait, had a short nap, yawned in a very pointed and offensive manner in our direction, and proceeded to roll on his back with obvious pleasure. He finally came to rest in the most ludicrous manner possible with all four legs pointing into the air. He then rose and wandered off to the well a couple of hundred yards away and had a long and satisfying drink from the water trough. He next returned and went to sleep.

In the meanwhile a comedy had been enacted under the solitary tree. There was little food left for the two lionesses, for the lion had consumed at least half of the buffalo—a well grown young buffalo—so a situation had arisen in which the two of them were eating at the opposite ends of the remaining piece of hide that contained any quantity of eatable meat. This did not suit either of them and an awe-inspiring fight took place—awe-inspiring to see and listen to but I fancy sound and fury signifying nothing, because there was no visible damage to either of them The conclusion of the matter was that the younger and smaller lioness finally decided that the only way to preserve her share of the meal was to clamp her jaws firmly on to it and to remain so. And this she did for the next twenty minutes while the older lioness comfortably chewed away at the other end!

Finally when there was little meat of any kind left for them to finish we decided to leave. We took the pagis back to Sandbera and returned on our way to Sasan. The first jeep, travelling fast, disturbed the lion sleeping on the road and he had to make way quickly. He undoubtedly regarded this as most undignified for when we followed past a moment later he was viciously attacking the large lioness. The other two young lions had also appeared, but it was to be a hungry night for them as by this time there was nothing else to eat.

The behaviour of this pride was strange because prides generally live and feed together amicably.

# A SYSTEMATIC ACCOUNT OF SOME LITTORAL MARINE DIATOMS FROM THE WEST COAST OF INDIA

BY

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(*With* 72 *figures in the text*)

There is no record as yet of the Marine Diatoms from the West Coast of India, though Menon (1931), Iyer and his collaborators (1936), Menon (1945), and Subrahmanyan (1946) have given accounts of the Marine Diatoms occurring on the East Coast. In view of this fact, it was thought proper to investigate the Marine Diatoms of the West Coast of India and to give firstly a systematic enumeration of the littoral diatoms belonging to the Saurashtra and Bombay Coasts. The actual places of collection belonging to this coast are Okha Port, Dwarka, Porbandar, Veraval, and Bombay. The forms enumerated were found to occur either as epiphytes attached on higher algae or were present in the sediment belonging to the intertidal region.

The preparation of the slides was done by taking small bits of the plants or sediment in a small dish containing Con. $HNO_3$ and heating it gradually for 25 minutes. The residue is then washed acid free by a repeated process of decantation with distilled water. The washed residue is very evenly distributed on a slide already smeared with Mayer's albumin. The slide is then warmed over a low flame and it is passed through 90%—100 % alcoholic grades to xylol and finally mounted in Canada Balsam or Styrax. Identification of the forms is based on the key provided by Hustedt ($1930_a$, $1930_b$, 1931, and 1937), although other works have also been consulted, e.g., Smith (1853, 1856), De-Toni (1891-94), Kolbe (1932), and Fritsch (1935).

In all 69 forms have been described, representing 25 genera. Out of these 9 genera and 20 forms belong to the group Centrales, and 17 genera and 49 forms to the Pennales. Of the total forms described 8 represent new species, and 6 are new varieties.

## SYSTEMATIC ENUMERATION

1. **Melosira dubia** Kütz. Hustedt in Rabenhorst's *Kryptogamen Flora von Deutschland, Österreich und der Schweiz*, Bd. VII, Die Kieselalgen, Tiel 1, p. 234, fig. 97, 1930b.

Frustules linked in long chains by means of gelatinous cushion. Cells spherically-ellipsoidal with a short mantel, cell-wall strong. Sulkus and neck absent. Pseudosulkus present. Fine puncta striation parallel and regularly arranged. Marginal tooth absent (text-fig. 1).

Diam. frustule, 22–30$\mu$.
Height of the half cell, 11–13$\mu$.
Punctae striations, 32 in 10$\mu$.

Except for the greater dimensions, and the larger number of punctae striations, the form agrees with the type closely.

Habitat: Veraval, Dwarka. Epiphytic on *Cladophora*.

2. **Melosira juergensi** Ag. Hustedt, op. cit., p. 238, fig. 99. 1930b.

Frustules linked in long chains, cylindrical with round, convex ends, longer than broad. Shell mantel strong, arched. Sulkus and neck absent, pseudosulkus present. Membrane sieve-like with thick net of pore canal. Girdle band with strong pervalvar striations (text-fig. 2).

Diam. frustule, 25–28$\mu$.
Height of the half cell, 9–13$\mu$.
Punctae striations, 10–12 in 10$\mu$.

The form resembles the type closely, but differs from the same in possessing larger number of punctae striations.

Habitat: Dwarka, Bombay. Epiphytic on *Ectocarpus*.

3. **Melosira sulcata** (Ehrenb.) Kütz. Hustedt, op. cit., p. 276, figs. 118, 119, 1930b.

Frustules linked in long chains. Cells disc-shaped. Shell with a short cylindrical strong mantel, base strongly incised. Disc flat in the middle. Sulkus and neck absent, pseudosulkus present. The mantel possesses a thinner ground membrane with a hollow cavity. The flat portion of the disc shows radial ribs or furrows. Basal incised portion of the disc with small narrow ring of pores arranged in the mantel structure, numerous irregular chambers without walls present in the mantel (text-fig. 3).

Diam frustule, 7–9$\mu$.
Height of the frustule, 2–3$\mu$.
Pores rows in pervalvar axis, 12 in 10$\mu$.

The form closely resembles the type, but it differs from the same in its smaller size, and in the possession of larger pores.

Habitat: Dwarka, Porbandar, Veraval. Epiphytic on *Ceramium*.

4. **Podosira montagnei** Kütz. Hustedt, op. cit., p. 281, fig. 122, 1930b.

Frustules in short pairs, bound by gelatinous stalks in chains, lentiform with convex disc without shell mantel. Disc with separate sectors, crossed by punctae rows, inner half of each sector shows parallel radial rows and two intercrossing striation system. Umblicus absent. Central portion of the disc indistinct (text-fig. 4).

Diam. frustule, 32–34$\mu$.
Areole, 20 in 10$\mu$.

The form agrees closely with *Podosira montagnei* Kütz. It, however, differs from the same in more stronger areole rings.

Habitat: Dwarka, Veraval, Bombay. Epiphytic on *Cladophora*.

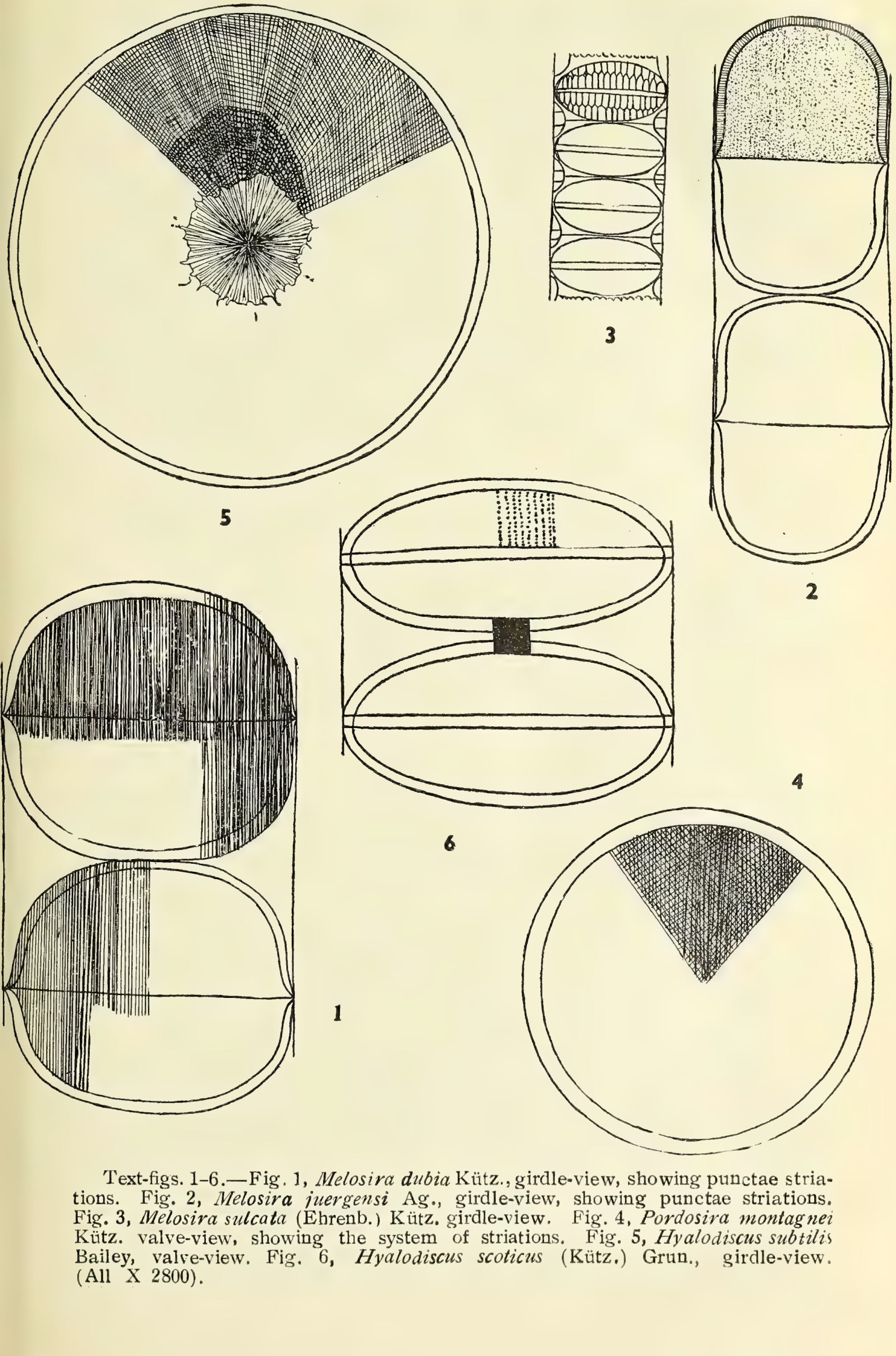
5. **Hyalodiscus subtilis** Bailey. Hustedt, op. cit., p. 291, fig. 132, 1930b.

Frustules with umblicate centre, flat, lentiform, shell slightly convex, watch-glass-shaped. Umblicus ring shaped with irregular rim punctae. Minute reduced punctae present in the umblicus which are radially arranged. Disc crossed with radial punctae rows (text-fig. 5).

Diam. frustule, 52–62$\mu$.
Diam. Umblicus, 18–24$\mu$.
Areole in the Umblicus, 25 in 10$\mu$.

The form agrees closely with the type.

Habitat: Dwarka. Epiphytic on *Gracilaria*.



Text-figs. 1–6.—Fig. 1, *Melosira dubia* Kütz., girdle-view, showing punctae striations. Fig. 2, *Melosira juergensi* Ag., girdle-view, showing punctae striations. Fig. 3, *Melosira sulcata* (Ehrenb.) Kütz. girdle-view. Fig. 4, *Pordosira montagnei* Kütz. valve-view, showing the system of striations. Fig. 5, *Hyalodiscus subtilis* Bailey, valve-view. Fig. 6, *Hyalodiscus scoticus* (Kütz.) Grun., girdle-view. (All X 2800).

6. **Hyalodiscus scoticus** (Kütz.) Grun, Hustedt, op. cit., p. 293, figs. 131 and 133, 1930b.

Frustules linked in short chains lens-shaped with convex shell. Shell membrane striated, striations parallel and punctate (text-fig. 6).

Diam. frustule, 30–33$\mu$.
Height of the half shell 8–9$\mu$.
Striations, 12–14 in 10$\mu$.

The form agrees closely with the type, but the striations and the punctae are bigger in the present diatom.

Habitat : Dwarka, Porbandar. Epiphytic on *Polysiphonia.*

7. **Coscinosira oestrupii** Ostenfeld. Hustedt, op. cit., p. 318, fig. 155, 1930b.

Frustules bound in long chains, gelatinous ring being always present between two frustules, middle band very distinct. Frustules short, cylindrical with flat or slightly arched shell. Disc strongly areoled, areoles smaller near the rim. Marginal spines of the disc absent, shell mantel is pervalvar band. Striped striations in the girdle band (text-fig. 7).

Diam. frustule, 10$\mu$.
Areole, 9 in 10$\mu$.

The form agrees well with the type.

Habitat : Dwarka, Veraval, Bombay. Epiphytic on *Cladophora.*

8. **Thalassiosira tropica** sp. nov.

Frustules linked in long chains, drum-shaped, octagonal in outline. Disc flat with hollow centre, punctae striated. Punctae in the middle irregular, but radially arranged towards the edge. On the disc margin spines are present. Spines minute and remote (text-fig. 8).

Diam. frustule, 29–33$\mu$.
Striations, 8–9 in 10$\mu$.
Punctae, 9-10 in 10$\mu$.

The Indian diatom resembles *Thalassiosira nordenskioldi* Clev. (Hustedt, op. cit., p. 321, fig. 157, 1930b.), due to its drum-like octagonal form in the girdle-view. It further resembles the same on account of possessing spines on the margins, and punctae striations on the surface of the frustules in valve-view. It, however, differs from the same in having much smaller spines on the rim and lesser number of punctae striations on its valves, which are 8-9 in 10$\mu$ in the present diatom, while they are 16-18 in 10$\mu$ in *T. nordenskioldi*, besides the punctae are much bigger. Moreover, *T. nordenskioldi* occurs in the colder regions of the European seas and polar waters, whereas, the present form is found in the tropical sea.

Habitat ; Porbandar. Epiphytic on *Caulerpa.*

Accedit ad *T. nordenskioldi* Clev. forma octogona tympanacea, spinulis ad margines atque striis punctorum ; ab ea tamen differt spinulis minoribus, striarum numero minori (in praesenti specie 8—9 in 10$\mu$, in altera vero specie 16—18) punctis multo majoribus, distributione tropicali (*T. nordenskioldi* vero invenitur tantum in regionibus articis vel in frigidioribus partibus Europae).

9. **Cyclotella meneghiniana** Kütz. Hustedt, op. cit., p. 341, fig. 174, 1930b.

Frustules flat disc-shaped. Shell with radially ribbed distinct margin, striations strong, wedge-shaped, uniform throughout. The central area appears ordinarily smooth but under very high magnification shows fine punctate striations, (text-fig. 9).

Diam. frustule, 15–17μ.
Striations, 9 in 10μ.

The form agrees well with the type.

Habitat: Dwarka. Epiphytic on *Polysiphonia.*

10. **Coscinodiscus finicus** sp. nov.

Frustules discoid flat, slightly depressed in the centre, with the margin faintly sloping. Disc plain with polygonal, six-sided (Hexagonal) areoles, areole big arranged in three systems of tangential rows. Areole row arched in one shell, in the other shell of a different frustule the disc possesses perfectly straight tangential row of areoles, that is, the system of areole is one and is straight tangential.

The margin of both the types of discs is striated, and the striations are strong and parallel. A ring of minute spines is also present on the disc margin (text-fig. 10).

Diam. frustule, 36–39μ.
Punctae in the centre, 3–9 in 10μ.
Striations in the margin, 8–10 in 10μ.

The Indian diatom closely resembles *Coscinodiscus excentricus* Ehrenb. (Hustedt, op. cit., p. 388, fig. 201, 1930 b) in general structure. It, however, differs from the same in having finer punctae, which in the present form are 3-9 in 10μ whereas, they are 3-5 in 10μ in *C. excentricus.* Further, the present diatom possesses much closer striation on the margin.

Habitat: Dwarka, Veraval, Bombay. Epiphytic on *Cladophora.*

Nova species accedit ad *C. excentricum* Ehrenb. structura generali, ab eo tamen differt punctis minoribus, numero 3-9 in 10μ (in *C. excentrico* 3-5 in 10μ) atque striis marginalibus propius dispositis.

11. **Coscinodiscus bathyomphalus** Cleve. Hustedt, op. cit. p. 431, fig. 234, 1930 b.

Disc with a large circular areoled area. Areole big, spirally arranged. Outside the circular area, the disc plain is radially areoled, with hyaline intercalary spaces between the areole row. Margin striated, striations fine. Indistinct minute spines present on the margin (text-fig. 11).

Diam. frustule, 27–30μ.
Areole of the disc, 15 in 10μ.
Areole in the centre, 15 in 10μ.
Striations of the margin, 20 in 10μ.

The Indian diatom closely resembles the type.

Habitat: Dwarka, Porbandar. Epiphytic on *Bryopsis.*

12. **Triceratium robertsianum** Grev. var. **dwarkensum** var. nov.

Frustules triangular in valve-view. Shell with an arched valve, which is convex on the margin, areole of the valvar plain closely fitting and irregularly distributed, sides perforated and spiny. Primary membrane radially striated. Apophysis of the shell remarkably strong. Frustules in zig-zag chains bound by means of gelatinous stalks situated between the neighbouring apophysis or processes (text-fig. 12).

Long. frustule, 105μ.
Areole, 4 in 10μ.

The Indian form agrees well with *Triceratium robertsianum* Grev. in its general features (Hustedt, op. cit., p. 803, fig. 466, 1930b), but it differs from the same in having irregular instead of the regular arrangement of the areoles in its valve-view. Further, the areoles in the present form are much bigger than those of the type.

Habitat: Dwarka. Epiphytic on *Polysiphonia.*

Accedit ad speciem typicam multis in notis; ab ea tamen differt irregulari dispositione areolarum, atque areolis multo majoribus.

13. **Triceratium spinosum** Bailey, forma **tetragona** Hust. Hustedt, op. cit., p. 806, fig. 468, 1930b.

Frustules tetragonal, sides concave, apophysis elongated. Valve-view areoled, areoles hexagonal. Margin striated. Apex of the apophysis smooth. Minute thorns present on the margin (text-fig. 13).

Long. frustule, 30–34$\mu$.
Areole, 3 in 10$\mu$.
Striations, 4 in 10$\mu$.

The form agrees well with the forma type.

Habitat: Porbandar. Epiphytic on the disc of *Codium.*

14. **Triceratium dubium** Brightw. Hustedt, op. cit., p. 806, fig. 469, 1930b.

Frustules bound in zig-zag chains, triangular, with concavity on all sides, middle area broad with areoles irregularly arranged. Areoles of different sizes, inner side perforated. Membrane areole punctate, base with radially striated margin. Apophysis cone-shaped, attenuated, having areoled apex, and strongly built (text-fig. 14).

Long. frustule, 33–35$\mu$.
Areole of the membrane, 5 in 10$\mu$.
Marginal striations, 8 in 10$\mu$.

The present form agrees well with the type.

Habitat: Dwarka, Bombay. Epiphytic on *Polysiphonia.*

15. **Triceratium pentacrinus** (E.) Wallich, forma **quadrata** Hust. Hustedt, op. cit., p. 814, fig. 475, 1930b.

Frustules in zig-zag chains, shell flat with quadrangular valve, sides concave, middle portion of the valve convex. Apophysis very short. Valvar wall areoled with radially arranged ribs net, areole round and radially disposed, towards the outside in quincunx. Margin with short striations, minute thorns in the middle. Apices of the apophysis smooth (text-fig. 15).

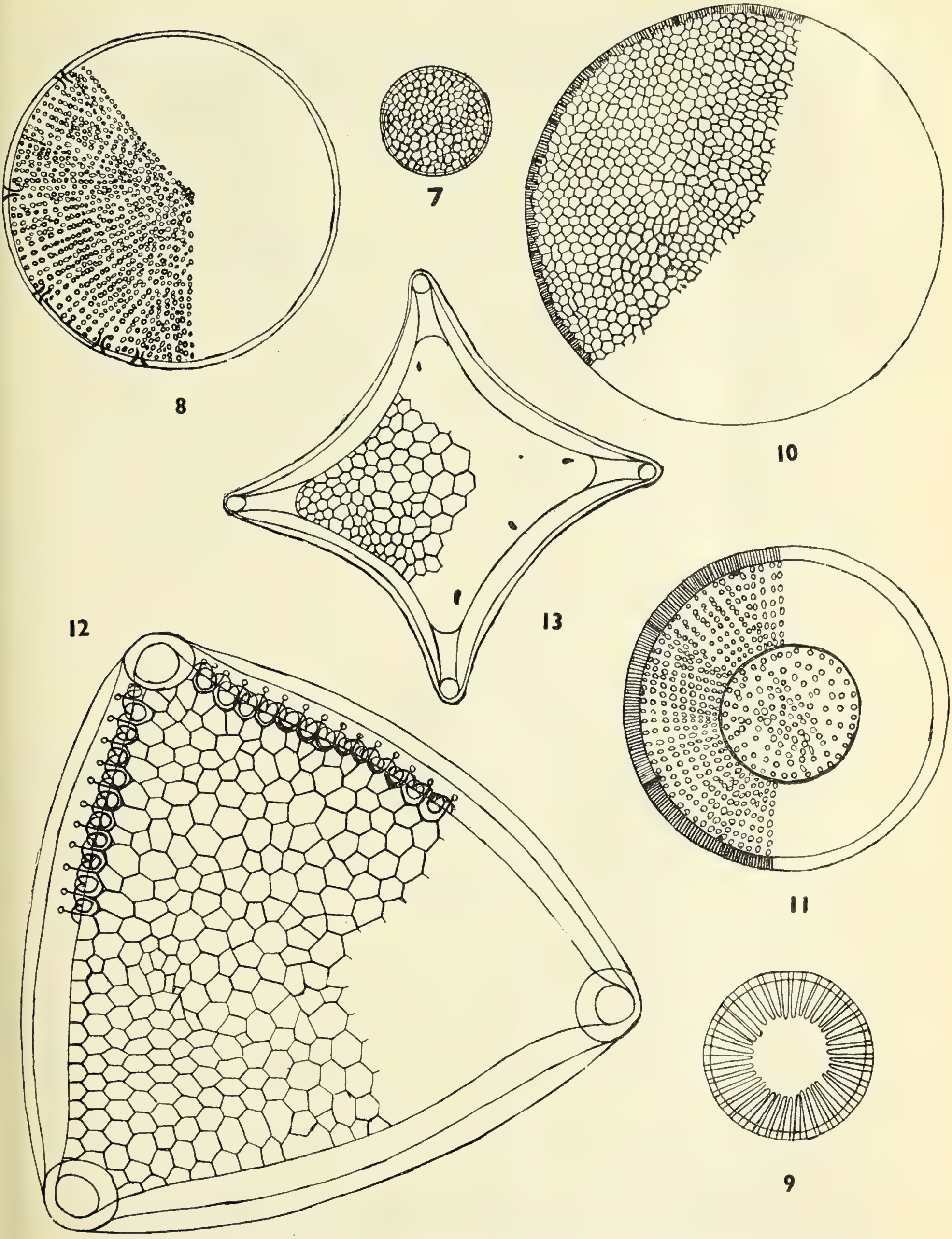
Long. shell, 80–90$\mu$.
Areole of the middle portion, 6 in 10$\mu$.
Areole of the apophysis, 10 in 10$\mu$.
Marginal striations, 10–12 in 10$\mu$.

The form closely resembles the type.

Habitat: Dwarka, Porbandar. Epiphytic on the disc of *Codium.*

16. **Triceratium balearicum** Cleve et Grun. forma **biquadrata** (Janisch) Hust. Hustedt, op. cit., p. 815, fig. 477, 1930b.

Frustules arranged in zig-zag chain, flat with quadrangular valve having concave sides, the middle region of the valve convex, apophysis short. Frustule wall of the shell areoled, and provided with ribs arranged



Text-figs. 7-13.—Fig. 7, *Coscinosira oestrupii* Ostenfeld, valve-view. Fig. 8, *Thalassiosira tropica* sp. nov. a disc in valve-view, showing arrangement of punctae. Fig. 9, *Cyclotella meneghiniana* Kütz. valve-view. Fig. 10, *Coscinodiscus finicus* sp. nov., valve-view, showing hexagonal areoles. Fig. 11, *Coscinodiscus bathyomphalus* Clev. valve view. Fig. 12, *Triceratium robertsianum* Clev. var. *dwarkensum* var. nov. valve-view, showing areoles. Fig.13, *Triceratium spinosum* Bailey forma *tetragona* Hust., valve-view, (All X 2800).

radially throughout. Areoles rounded in radial rows, near the edges quincunxially arranged and distantly situated. Basal shell margin beset with continuous strong radial striae. Apex of the apophysis smooth (text-fig. 16).

Long. frustule, 60–68$\mu$.
Areole in the middle part, 6–7 in 10$\mu$.
Areole in the apophysis, 6 in 10$\mu$.
Striations of the margin, 7–10 in 10$\mu$.

The form agrees well with type.

Habitat: Porbandar, Veraval. Epiphytic on *Cladophora.*

17. **Biddulphia pulchella** Gray. Hustedt, op. cit., p. 832, fig. 490, 1930b.

Frustules adhering in zig-zag chain. Valves elliptical, spinose, angles of the apical axis produced into rounded process. Valves provided with long sutures. Frustules pseudozygomorphic. Angles of the valve distinctly structured with perforations, the edges of the valve slightly silicious, otherwise strongly silicified. Cell membrane areoled, areoles big, rounded and free from each other. Margin of the frustules undulating. Middle portion of the valve elevated. Girdle band likewise areoled, but the areoles here are much finer, arranged in rows. Areoles of the processes also very fine (text-fig. 17).

Long. apical axis, 90–150$\mu$,
Long. transapical axis, 111–120$\mu$.
Areole of the membrane, 5 in 10$\mu$.
Areole of the process, 20 in 10$\mu$.

The form agrees well with the type.

Habitat: Dwarka. Epiphytic on *Bryopsis.*

18. **Biddulphia rhombus** (Ehrenb.) Smith. Hustedt, op. cit., p. 842, figs. 496, 497, 1930b.

Valve elliptic-lanceolate, processes horn-shaped, twisted, valve plain convex, sloping near the margin, wall of the valve strongly silicious, areoled throughout, areoles arranged in quincunx. Short spines attached to the margin. Girdle-view rectangular. Girdle band areoled, the areoles are smaller (text-fig. 18).

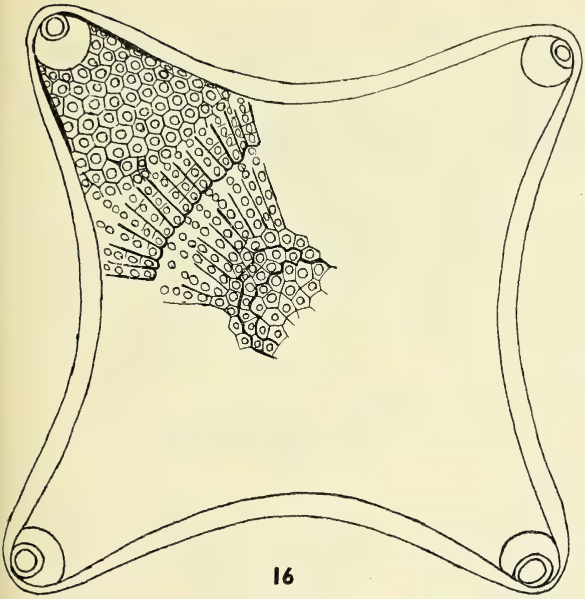
Long. apical axis, 65–72$\mu$.
Long. transapical axis, 59–71$\mu$.
Areole of the valve, 8 in 10$\mu$.
Areole of the girdle band, 12 in 10$\mu$.

The form resembles the type closely.

Habitat: Porbandar. Epiphytic on the disc of *Ulva.*

19. **Biddulphia aurita** (Lyngb.) Brébisson et Godey. Hustedt, op. cit., p. 846, fig. 501, 1930b.

Frustules bound in zig-zag chains, individual frustule barrel-shaped. Valve elliptical-lanceolate with a long pervalvar axis. Valvar plain in the middle portion convex, sloping in the margin, possessing two awl-shaped spines, poles of the apical axis horn-like, obtuse, slightly twisted at the apex and inflated in the base. Wall of the valve strongly silicious. Membrane areoled punctate, the punctae are big, round and free from each other, and are arranged radially. The areoles of the girdle band



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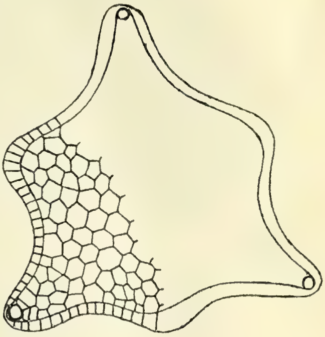

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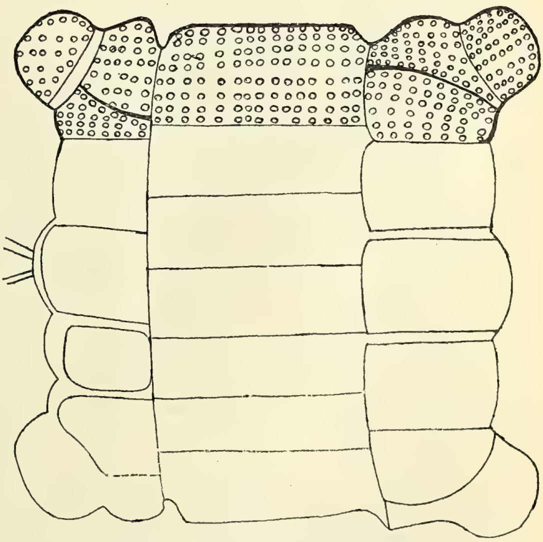

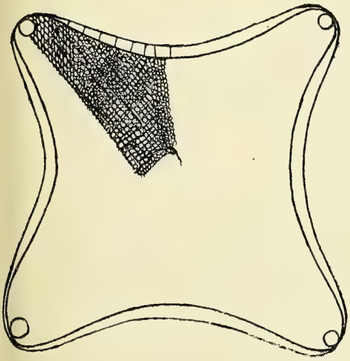

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Text-figs. 14-17.—Fig. 14, *Triceratium dubium* Brightw., valve-view. Fig. 15, *Triceratium pentacrinus* (E.) Wallich. forma *quadrata*, Hust., valve-view. Fig. 16, *Triceratium balearicum* Clev. and Grun., forma *biquadrata* (Janisch) Hust., valve-view. Fig. 17, *Biddulphia pulchella* Gray, girdle-view. (14 and 16, × 2800 ; 15, × 1400 ; 17, × 1530).

arranged in straight rows. The processes are also areoled likewise. Apical portion of the processes are smooth (text-fig. 19).

Long. apical axis, 50–59$\mu$.
Long. transapical axis, 20–39$\mu$.
Areole of the membrane, 9 in 10$\mu$.
Areole of the process, 10 in 10$\mu$.

The form closely resembles the type.

Habitat: Bombay. Epiphytic on the disc of *Padina*.

20. **Biddulphia levis** Ehrenb. Hustedt, op. cit., p. 852, fig. 506, 1930b.

Valve cylindrical, pervalvar axis much elongated, valvar plain convex, processes greatly reduced, valve throughout areoled. Areoles in very fine rows, middle area of the valve with irregularly arranged areoles (text-fig. 20).

Long. apical axis, 62$\mu$.
Long. transapical axis, 52$\mu$.
Areole in the valve, 18 in 10$\mu$.

The Indian diatom closely resembles the type.

Habitat: Dwarka. Veraval. Epiphytic on the pinna of *Bryopsis*.

21. **Rhabdonema indicum** sp. nov.

Frustules cemented with gelatinous cushion into long ribbons, linear in valve-view, and rectangular in girdle-view, with rounded edges, and long intercalary bands. Short apical and broad transapical septa are present. Valves round at the poles, linear, with three apertures, one central and two polar. Valvar plain with transapical rows extending throughout the breadth. Shell margin possesses minute pores, mantel plain with ribs of fine areole-punctae (text-fig. 21).

Long. frustule, 72–120$\mu$.
Lat. frustule, 51–58$\mu$.
Transapical rows, 5 in 10$\mu$.
Transapical areole, 10 in 10$\mu$.

The Indian diatom resembles *Rhabdonema adriaticum* Kütz. (Hustedt, op. cit., p. 23, fig. 552, 1931–32) on account of its rectangular frustules in the girdle-view, and in possessing intercalary band with transapical septa. But it differs from the same in having much broader frustules, possessing bigger transapical rows. It further differs from the same in possessing more prominent intercalary bands than the type.

Habitat: Dwarka. Epiphytic on the thallus of *Padina*.

Accedit ad *Rh. adriaticum* Kütz. frustulis rectangularibus, zona intercalari atque septis transapicalibus ; ab eo tamen differt frustulis latioribus, amplioribus seriebus transapicalibus, zona intercalari prominentiore.

22. **Grammatophora angulosa** Ehrenb. Hustedt, op. cit., p. 39, fig. 564, 1931–32.

Frustules in zig-zag chains, rectangular, round-edged. Septa curved, the inner end is hooked. Shell mantel and the intercalary band bridged with distinct line. Shell linear-elliptical with slightly convex sides, flat round apices, polar area hyaline. Transapical striations punctate, in long straight intercrossing rows (text-fig. 23).

Long. frustule, 16$\mu$.
Lat. frustule, 10$\mu$.
Transapical striations 12–16 in 10$\mu$.

The form closely resembles the type.

Habitat: Dwarka, Bombay. Epiphytic on *Cladophora*.

23. **Grammatophora hamulifera** Kütz. Hustedt, op. cit., p. 40, fig. 566, 1931–32.

Frustules bound in zig-zag chains, rectangular with round edges, possessing two intercalary bands. Septa strongly folded, curved at the base and hooked behind. In the girdle-view the septa appear characteristically C-shaped. Shell linear-elliptic with flat round edges, convex on the sides. Membrane with long straight intercrossing rows of transapical punctae. Pseudoraphe distinct and close. Hyaline polar area present (text-figs. 24a and b).

Long. frustule, 32·5$\mu$.
Lat. frustule, 17$\mu$.
Transapical striations, 17 in 10$\mu$.

Except for the greater breadth of its frustules, the Indian diatom resembles the type closely.

Habitat: Porbandar. Epiphytic on *Valoniopsis.*

24. **Grammatophora caulerpica** sp. nov.

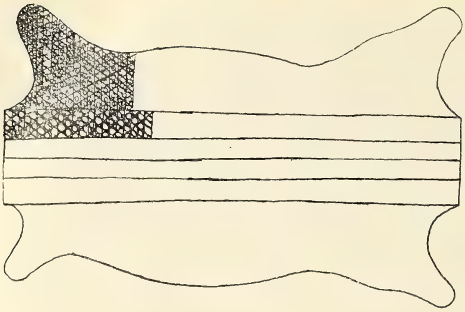
Frustules occurring in zig-zag chains, rectangular with round edges, possessing two intercalary bands. Septa more or less wavy, inner end more or less knobbed. Shell mantel and intercalary band separated by a distinct line. Shell broad, linear in the middle, transapical portion slightly bulged, ends broad and round. Transapical punctate striations in quincunx. Pseudoraphe short and close. Polar area short and hyaline (text-fig. 25).

Long. frustule, 17–20$\mu$.
Lat. frustule, 16–18$\mu$.
Transapical striations, 24–28 in 10$\mu$.

Due to the presence of a wavy septa, and on account of the edges of the frustules being round, the Indian diatom can be compared well with *Grammatophora marina* (Lyngb.) Kütz. (Hustedt, op. cit., p. 43, fig. 569, 1931–32). It further resembles the same in having its punctae quincuncially arranged. It, however, differs from the same in having broader frustules and in possessing greater number of transapical striations, which are 24–28 in 10$\mu$ in the present diatom while *G. marina* possesses 15–22 transapical striations in 10$\mu$. On account of possessing the same number of transapical striae it may be compared to *G. marina* var. *adriatica* Grun., but it differs from the same in greater dimensions of its frustules. Further the present form may also be compared to *G. marina* var. *tropica* (Kütz.) Grun. in its general features, but the present form differs from this variety in having larger number of transapical striations, it further differs from the same in having smaller size of its frustules. With both of the above varietal type it differs also in possessing more wavy septa, which in the varieties are rather straight.

Habitat: Okha Port, Bombay. Epiphytic on *Caulerpa.*

Accedit ad *G. marinam* Kütz. septis sinuosis, marginibus frustulorum rotundatis, punctis quincuncialiter dispositis ; ab ea tamen differt frustulis latioribus, striis transapicalibus pluribus (24–28 in praesenti nova specie, 15–22 in altera specie in 10$\mu$). Numero striatum accedit ad *G. marinam* var. *adriaticam* Grun., a qua differt magnitudine ampliore frustulorum ; accedit etiam ad *G. marinam* var. *tropicam* Grun. multis in notis, sed differt numero majore striarum transapicalium et magnitudine minore frustulorum ; ab utraque varietate differt septis sinuosis, quae in varietatibus sunt fere recta.



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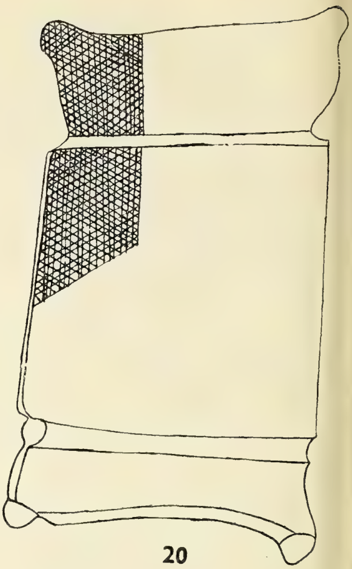

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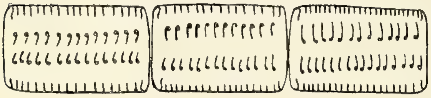

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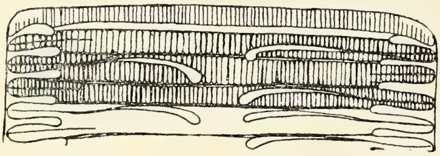

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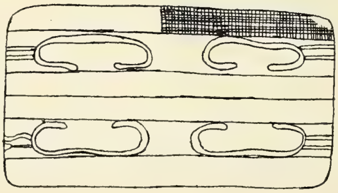

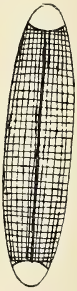

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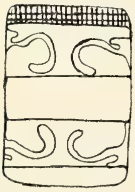

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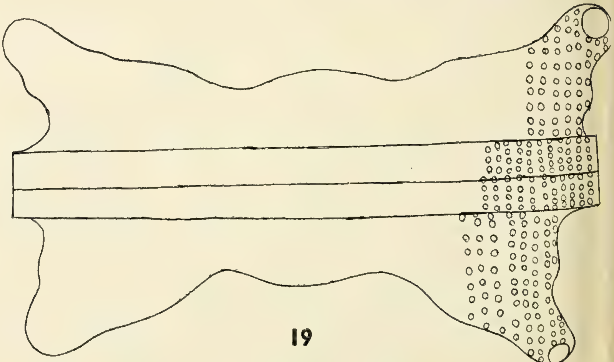

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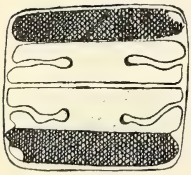

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Text-figs. 18–25.—Fig. 18, *Biddulphia rhombus* (Ehrenb.) Smith, girdle-view, showing areoles. Fig. 19, *Biddulphia aurita* (Lyngb.) Breb. et Godey, girdle-view. Fig. 20, *Biddulphia levis* Ehrenb. valve-view. Fig. 21, *Rhabdonema indicum* sp. nov., frustule in girdle-view. Fig. 22, *Rhabdonema indicum* sp. nov., a part of the frustule, showing intercalary bands. Fig. 23, *Grammatophora angulosa* Ehrenb. girdle-view. Fig. 24 a, b, *Grammatophora hamulifera* Kütz. frustules in girdle- and valve-view. Fig. 25, *Grammatophora caulerpica* sp. nov., girdle-view, showing septa and striations. (18, 19, 23, 24 a, b, 25, × 2800 ; 20, × 1500 ; 21, × 180 ; 22, × 2000).

25. **Grammatophora maxima** Grun. (Hustedt, op. cit., p. 44, fig. 572, 1931–32.

Frustules rectangular with straight prominent septa, shell linear-lanceolate, ends rounded, bulged in the middle, polar area short, hyaline, pseudoraphe narrow. Transapical punctae striations in quincunx (text-fig. 26).

Long. frustule, 52$\mu$.
Lat. frustule, 13$\mu$.
Transapical striations, 24 in 10$\mu$.

The form closely resembles the type.

Habitat : Porbandar. Epiphytic on the disc of *Ulva.*

26. **Grammatophora oceanica** (Ehrenb.) Grun., var. **macilenta** (Smith) Grun. Hustedt, op. cit., p. 47, fig. 573, 1931–32.

Frustules rectangular, thin-walled, septa long, straight, shell linear-lanceolate with flat round ends. Pseudoraphe narrow, polar area very small, hyaline. Transapical striations in quincunx, finely punctate (text-fig. 27 a, b).

Long. frustule, 65$\mu$.
Lat. frustule, 13$\mu$.
Transapical striations, 20 in 10$\mu$.

The Indian diatom resembles the type closely.

Habitat : Bombay. Epiphytic on the thallus of *Padina.*

27. **Licmophora flabellata** (Carm.) Ag. Hustedt, op. cit., p. 58, fig. 581, 1931–32.

Frustules in branched colony, attached to the host by a gelatinous stalk, keel-shaped with pointed edges in girdle-view, septa very short, intercalary band flat, straight. Valve-view narrow club-shaped, apical pole round. Valve tapering gradually towards the basal pole. Apical pole flat and arched. Transapical striations of extremely fine punctae, hardly visible near the base (text-fig. 28 a, b, c).

Long. frustule, 152–165$\mu$.
Lat. frustule, 26–30$\mu$.
Transapical striations, 26–30 in 10$\mu$.

The form resembles the type closely.

Habitat : Dwarka. Epiphytic on *Laurencia.*

28. **Licmophora bharadwajai** sp. nov.

Frustules keel-shaped in girdle-view, broad with round edges. Septa distinct, moderately deep, intercalary band flat, slightly curved. Valve broadest at the apical pole narrowing gradually towards the basal pole with concave margin. Transapical striations strongly developed. Intercalary space between the transapical striations, punctate fine in long row. Pseudoraphe distinct, narrow (text-figs. 29, 30 a, b).

Long. frustule, 39–78$\mu$.
Lat. frustule at the apex, 23–46$\mu$.
Lat. frustule at the middle, 26–39$\mu$.
Lat. frustule at the base, 4–8 $\mu$.
Transapical striations, 6–8 in 10$\mu$.

The Indian diatom resembles *Licmophora gracilis* (Ehrenb.) Grun., (Hustedt, op. cit., p. 60, fig. 582, 1931–32) due to the possession of keel-shaped frustules in girdle-view with flat, slightly curved intercalary band. It further resembles the same in possessing a broad round apical pole, while the margin in both the diatoms is concave near the basal pole. Moreover, they possess fine punctae between the transapical striations. *Licmophora bharadwajai* sp. nov. differs, however, from the same in being shorter in length, and wider in breadth, and in having lesser number of transapical striations, which in the Indian diatom are 6–8 in 10$\mu$, whereas they are 20–22 in 10$\mu$ in the type. It further differs from *Licmophora gracilis* (Ehrenb.) Grun. in having distinct and moderately deep septa, instead of short and indistinct as in the type. The present form may also be compared with *L. oedipus* (Kütz.) Grun., (Hustedt, op. cit., p. 62, fig. 585, 1931–32) due to the possession of similar frustules with the intercalary band flat or slightly curved, and in having fine punctae between the transapical striations. But the Indian form of *Licmophora* differs from the same in possessing distinct and moderately deep septa. It further differs from the same in possessing a lesser number of transapical striations, which in the type are 20–30 in 10$\mu$, while in the present diatom they are 6–8 in 10$\mu$.

Habitat : Dwarka, Veraval. Epiphytic on *Cladophora* and *Ceramium*.

Accedit nova haec species ad *L. gracilem* Grun. frustulis carinatis aspectu zonali, fascia intercalari tenuiter curvata ; polo apicali rotundato, latoque, marginibus concavis prope polum basalem ; differt vero longitudine breviore, latitudine latiore, striis transapicalibus paucioribus (6–8 in nova specie, 20–22 in 10$\mu$ in altera specie) ; porro differt septis distinctis et moderate altis. Nova species accedit etiam ad *L. oedipum* Grun. frustulis similibus, fascia intercalari plana vel paululum curvata, punctis minutis inter strias transapicales ; ab ea tamen differt numero minore striarum transapicalium, quae in specie typica sunt 20–30 in 10$\mu$.

29. **Licmophora abbreviata** Ag. Hustedt, op. cit., p. 66, fig. 590, 1931–32.

Frustules in girdle-view strongly keel-shaped, upper edges round. Septa long, deep. Intercalary band strongly curved (sinuous). Valve-view narrow, club-shaped, with broad apical pole having round edges, basal pole pointed round. Margin near the basal pole slightly concave. Transapical striations distinct throughout. Pseudoraphe narrow but distinct (text-fig. 31).

Long. frustule, 111$\mu$.
Lat. frustule at the apical pole, 18$\mu$.
Lat. frustule at the basal pole, 6$\mu$.
Transapical striations, 15–18 in 10$\mu$.

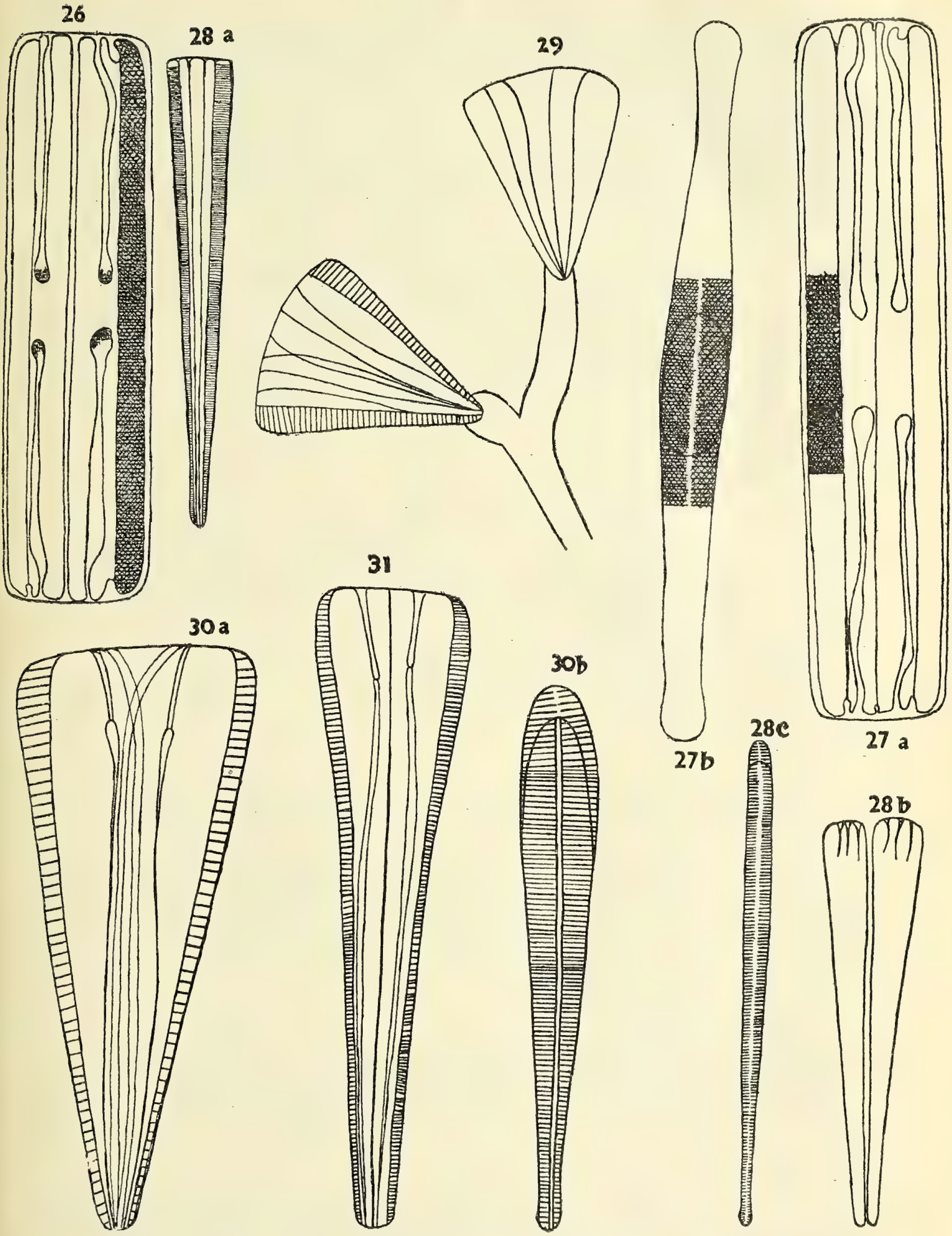
The present diatom resembles the type closely, except that it possesses a large number of transapical striations.

Habitat : Porbandar. Epiphytic on *Polysiphonia*.

30. **Licmophora paradoxa** (Lyngb.) Ag. var. **media** var. nov.

Frustule wedge-shaped in girdle-view, with broad round edged apical portion. Septa long, deeply piercing. Intercalary band curved. Valve club-shaped. Margin near the basal pole concave. Transapical striations distinct. Pseudoraphe narrow, but distinct (text-figs. 32, 33).

Long. frustule, 55–59$\mu$.
Lat. frustule, 8–10$\mu$.
Transapical striations, 24–28 in 10$\mu$.



Text-figs. 26-31.—Fig. 26, *Grammatophora maxima* Grun. girdle-view. Figs. 27 a, b, *Grammatophora oceanica* (Ehrenf.) Grun. frustules in girdle- and valve-view. Figs. 28 a, b, c, *Licmophora flabellata* (Carm.) Ag. girdle- and valve-view. Figs. 29, 30 a, b, *Licmophora bharadwajai* sp.nov. frustules in girdle- and valve-view, showing septa and transapical striations. Fig. 31, *Licmophora abbreviata* Ag. girdle-view. (26, 27 a, b, 30 a, b, ×2800; 28 a, b, c, × 700; 29, × 800; 31, × 1400).

The present diatom agrees with *Licmophora paradoxa* (Lyngb.) Ag., (Hustedt, op. cit., p. 76, fig. 605, 1931–32), in having distinct, deep septa, and in possessing the same general features. It, however, differs from the same in being smaller in size and in the possession of lesser number of transapical striations.

Habitat : Dwarka, Bombay. Epiphytic on *Padina*.

Accedit ad speciem typicam septis distinctis, altis, et notis aliis plurimis; ab ea differt magnitudine minore, striis transapicalibus paucioribus.

31. **Licmophora grandis** (Kütz.) Grun. var. **somnathii** var. nov.

Frustule in girdle-view long keel-shaped with round edges, septa deep piercing. Intercalary band feeble, sinuous. Valve-view narrow club-shaped, broad at the apical pole, narrowing towards the basal pole. Basal pole round. Transapical striations distinct throughout. Pseudoraphe prominent (text-fig. 34 a, b, c, d).

Long. frustule, 90–105$\mu$.

Lat. frustule, 5$\mu$.

Transapical striations, 20–28 in 10$\mu$.

The Indian diatom resembles *L. grandis* (Kütz.) Grun., (Hustedt, op. cit., p. 76, fig. 608, 1931–32) due to its general characters. But it differs from the same in possessing sinuous to almost straight intercalary band. It further differs from the type in having narrower frustules with greater number of transapical striations.

Habitat : Veraval, Porbandar. Epiphytic on *Ceramium*.

Accedit ad speciem typicam multis in notis ; ab ea recedit fascia intercalari sinuata vel fere recta, frustulis angustioribus, striis transapicalibus pluribus.

32. **Licmophora communis** (Heib.) Grun. Hustedt, op. cit., p. 79, fig. 610, 1931–32.

Frustule wedge-shaped in girdle-view with round edges. Septa deeply piercing. Intercalary band sinuous. Valve-view club-shaped with broad round apical pole. Margin straight, but concave near the basal pole. Transapical striations faint in the apical part, while prominent in the basal region. Pseudoraphe distinct (text-fig. 35 a, b).

Long. frustule, 36–39$\mu$.

Lat. frustule, 6–7$\mu$.

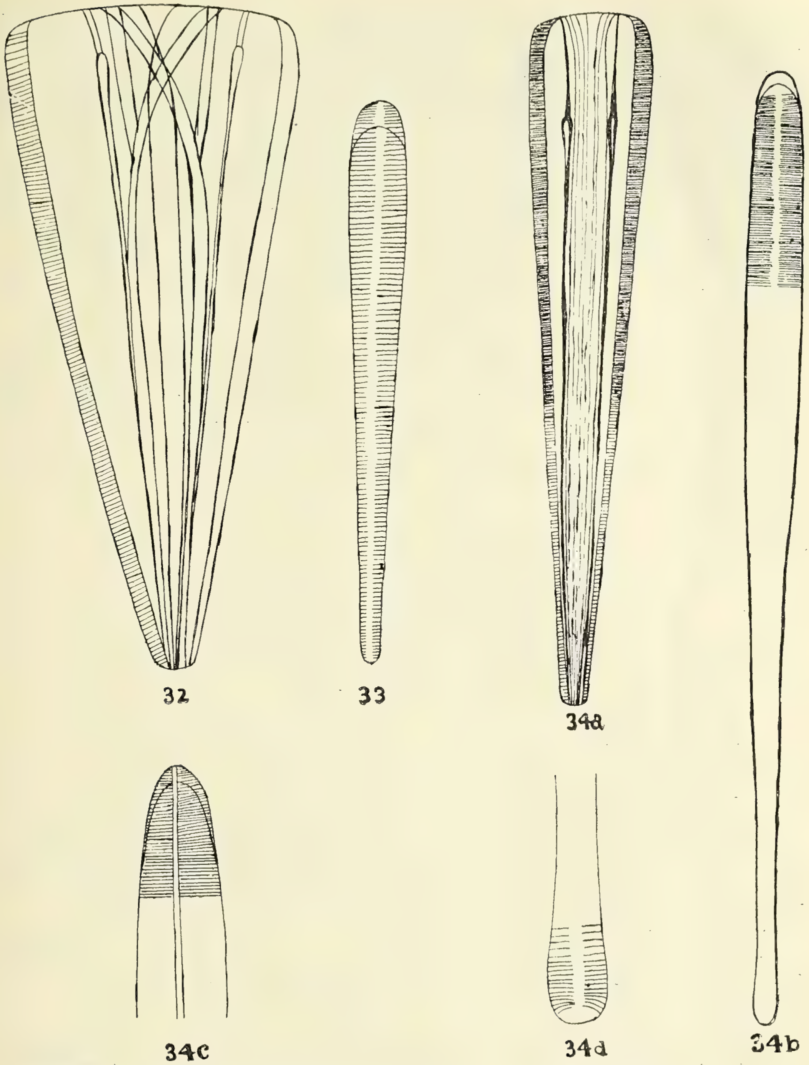
Transapical striations, 12 in 10$\mu$.

The form resembles the type closely.

Habitat : Dwarka. Epiphytic on the basal disc of *Dictyota*.

33. **Climacosphenia littoralis** sp. nov.

Frustule in girdle-view wedge-shaped with perfectly straight margins. Intercalary bands straight, running throughout the length of the frustule with numerous septa. Frustule in valve-view club-shaped with circular ends, broad at the apical pole narrowing towards the basal pole. Septa irregularly round to oval, larger in the upper portion, while smaller in the lower region becoming oval in shape. Transpical striations fine, straight. Striations in the middle portion of the shell finely punctate. Punctae minute irregularly disposed (text-figs. 36 a, b, c).



Text-figs. 32–34 d.—Fig. 32, 33, *Licmophora paradoxa* (Lyngb.) Ag. var. *media*, var. nov. girdle- and valve-view, Figs. 34 a, b, *Licmophora grandis* (Kütz.) Grun., var. *somnathii* var. nov. girdle- and valve-view showing septa and transapical striations. Figs. 34 c, d, same, showing apical and basal parts of the valve-view. (32, 33, 34 c, d, × 2800; 34 a, b, × 1400).

Long. frustule, 380–460$\mu$.
Lat. frustule at the apex, 40–58$\mu$.
Lat. frustule at the middle, 20–35$\mu$.
Lat. frustule at the base, 10–13$\mu$.
Striations in the upper portion, 25 in 10$\mu$.
Striations in the middle portion, 10–12 in 10$\mu$.
Striations in the lower portion, 14–20 in 10$\mu$.

The Indian diatom resembles the type *Climacosphenia moniligera* Ehrenb. (Hustedt, op. cit., p. 89, figs. 625, 626, 1931–32) in possessing keel-shaped frustules in the girdle-view, having straight margins, and club-shaped in the valve-view. It further agrees with the same in having numerous septa and well developed transapical striations which are punctate in the middle part of the frustules. The Indian diatom, however, differs from the same in having more or less round to oval septa, while in the type they are roundish to elliptical. Further the present form has irregularly disposed punctae in the middle region, and the number of transapical striations also vary from those of the type for the corresponding regions. Moreover, the frustules of the Indian diatom are broader.

Habitat : Dwarka. Epiphytic on *Chamaedoris.*

Species haec indica accedit ad *moniligeram* Ehrenb. frustulis carinatis, marginibus rectis aspectu zonali, clavatis vero aspectu valvali, septis plurimis, striis transapicalibus bene evolutis punctatis in media parte frustulorum; ab ea tamen recedit septis plus minusve rotundatis vel ovalibus, punctis irregulariter dispositis in regione media, striis transapicalibus numero diversis ; porro frustulis latioribus.

34. **Plagiogramma pulchellum** Grev. var. **intermedia** var. nov.

Frustules rectangular in girdle-view, margins straight with round edges. Valve linear-elliptic with blunt round edges. Pseudoraphe deep, piercing. One pair in the middle and a single on each end of the valve. Transapical striations punctate, bigger in the middle than those on the ends, punctae in long radial rows (text-fig. 37).

Long. frustule, 19–21b $\mu$.
Lat. frustule, 4–5$\mu$.
Striations, 5–8 in 10$\mu$.
Punctae, 7–9 in 10$\mu$.

The present form resembles *Plagiogramma pulchellum* Grev. var. *pigmea* (Grev.) Pergallo, (Hustedt, op. cit., p. 108, fig. 634, 1931–32) closely in general structure, but it differs from the same in being larger in size and in possessing lesser number of transapical striations.

Habitat : Bombay. In sediment.

Accedit ad speciem typicam structura generali, recedit vero magnitudine ampliore et numero striarum transapicalium minore.

35. **Podocystis ovalis** sp. nov.

The frustules are attached with their basal pole to the thallus of *Polysiphonia* by means of a gelatinous cushion. The shell is oval in valvar-plain. Valve membrane traversed by apical and transapical striations, which form a net-like system. The striations are areoled, which are round, slightly elongated, that is, oblong in shape (text-fig. 38).

Long. frustule, 52–58$\mu$.
Lat. frustule, 42–48$\mu$.
Transapical striations, 6 in 10$\mu$.
Areoles, 8 in 10$\mu$.

The present diatom resembles *Podocystis spathulata* (Shadb). Heurck. (Hustedt, op. cit., p. 133, fig. 653, 1931–32) on account of a more or less similar shape, and in the possession of apical and transapical striations which are areoled. It, however, differs from the same in being oval or egg-shaped instead of spathulate. Further in comparison to the above type the Indian diatom has smaller frustules. Moreover, the transapical striations are more prominent and the areolation is in one row, further the apical axis of the Indian form is broader than that of *P. spathulata.*

Habitat: Okha Port, Dwarka. Epiphytic on *Polysiphonia.*

Proxima *P. spathulatae* Heurck. forma, et aliis notis ; ab ea differt forma ovali nec spathulata, frustulis minoribus, striis transapicalibus prominentioribus, areolatione uniseriata, axi apicali latiore.

36. **Frigilaria cylindrus** Grun. Hustedt, op. cit., p. 152, fig. 665, 1931–32.

Frustules occurring in thick bands, rectangular in girdle-view. Valve linear with broad round ends. Transapical striations prominent. Pseudoraphe very narrow (text-fig. 39).

Long. frustule, 10–13μ.
Lat. frustule, 3–5μ.
Transapical striations, 20 in 10μ.

The form resembles the type closely.

Habitat: Okha Port, Bombay. In sediment.

37. **Synedra kashyapiens** sp. nov.

Frustules existing individually. Valve narrow, linear to lanceolate with slightly curved round ends. Transapical striations prominent. Pseudoraphe distinct, narrow and linear, central hyaline area absent (text-fig. 40).

Long. frustule, 45–68μ.
Lat. frustule, 4–5μ.
Transapical striations, 13–14 in 10μ.

The present diatom resembles *Synedra investiens* Smith (Hustedt, op. cit., p. 209, fig. 699, 1931-32) in its general construction, but it differs from the same in having larger frustules possessing greater number of transapical striations. Further the pseudoraphe is not as narrow, but broader than that in the Smith's species.

Habitat: Porbandar, Veraval. In the sediment.

Ad *S. investientem* Smith accedit structura generali, ab ea differt frustulis largioribus, numero majore striarum transapicalium, pseudoraphe latiore.

38. **Synedra famelica** Kütz. Hustedt, op. cit., p. 210, fig. 701, 1931–32.

Frustules individually existing. Valve broad-lanceolate, narrow in the lower portion with round apices. Transapical striations fine. Pseudoraphe very narrow and hardly recognisable. Central hyaline area absent (text-fig. 41).

Long. frustule, 36–39μ.
Lat. frustule, 3–4μ.
Transapical striations, 15–18 in 10μ.

The form closely resembles the type, but possesses lesser number of transapical striations.

Habitat: Porbandar, Veraval. In sediment.

39. **Synedra hyperborea** Grun. var. **rostellata** Grun. Hustedt, op. cit., p. 217, figs. 709 k, 1, 1931–32.

Frustules occurring individually, valve linear-lanceolate, abruptly narrowing towards the apices, round on the poles. Transapical striations extremely fine, pseudoraphe narrow and linear, central hyaline area absent (text-fig. 42).

Long. frustule, 50–55μ.
Lat. frustule, 4μ.
Transapical striations, 24 in 10μ.

The present form closely resembles the varietal type.

Habitat: Dwarka. Epiphytic on *Bryopsis* and *Laurencia.*

40. **Synedra tabulata** (Ag.) Kütz. var. **fasiculata** (Kütz.) Grun. Hustedt, op. cit., p. 218, figs. 710 i-1, 1931-32.

Frustules freely occurring. Valve long-lanceolate, without curved end, poles broad, round, transapical striations short and fine. Pseudoraphe broad and distinct (text-fig. 43).

Long. frustule, 39–52μ.
Lat. frustule, 6μ.
Transapical striations, 11–12 in 10μ.

The form resembles the varietal type closely.

Habitat: Bombay. Epiphytic on the thallus of *Padina.*

41. **Synedra closterioides** Grun. Hustedt, op. cit., p. 222, fig. 712, 1931–32.

Frustules curved like a bow, bulged in the middle narrowing towards the bent apices. Transapical striations very fine, pseudoraphe narrow and uniform throughout (text-fig. 44).

Long. frustule, 32–48μ.
Lat. frustule, 3–4μ.
Transapical striations, 20 in 10μ.

The form agrees well with the type.

Habitat: Bombay. Epiphytic on *Cladophora.*

42. **Cocconeis clandestina** Schmidt. Hustedt, op. cit., p. 331, fig. 784, 1931-32.

Frustules attached to *Dictyota* thallus with their raphe-shell. Elliptical in valvar plain, intercalary band and septa absent. Rapheless shell or the epitheca with flat transapical striations. Intercalary space between the striations prominently punctate, punctae big and round, towards the poles in three rows, in the middle there are usually two rows only. The punctae system is in straight line; pseudoraphe linear hyaline. Raphe-shell or the hypotheca with fine radial transapical punctate row, punctae arranged in long faint wavy rows. Raphe straight, axial area narrow, central area round bulged. Valvar margin hyaline (text-fig. 45).

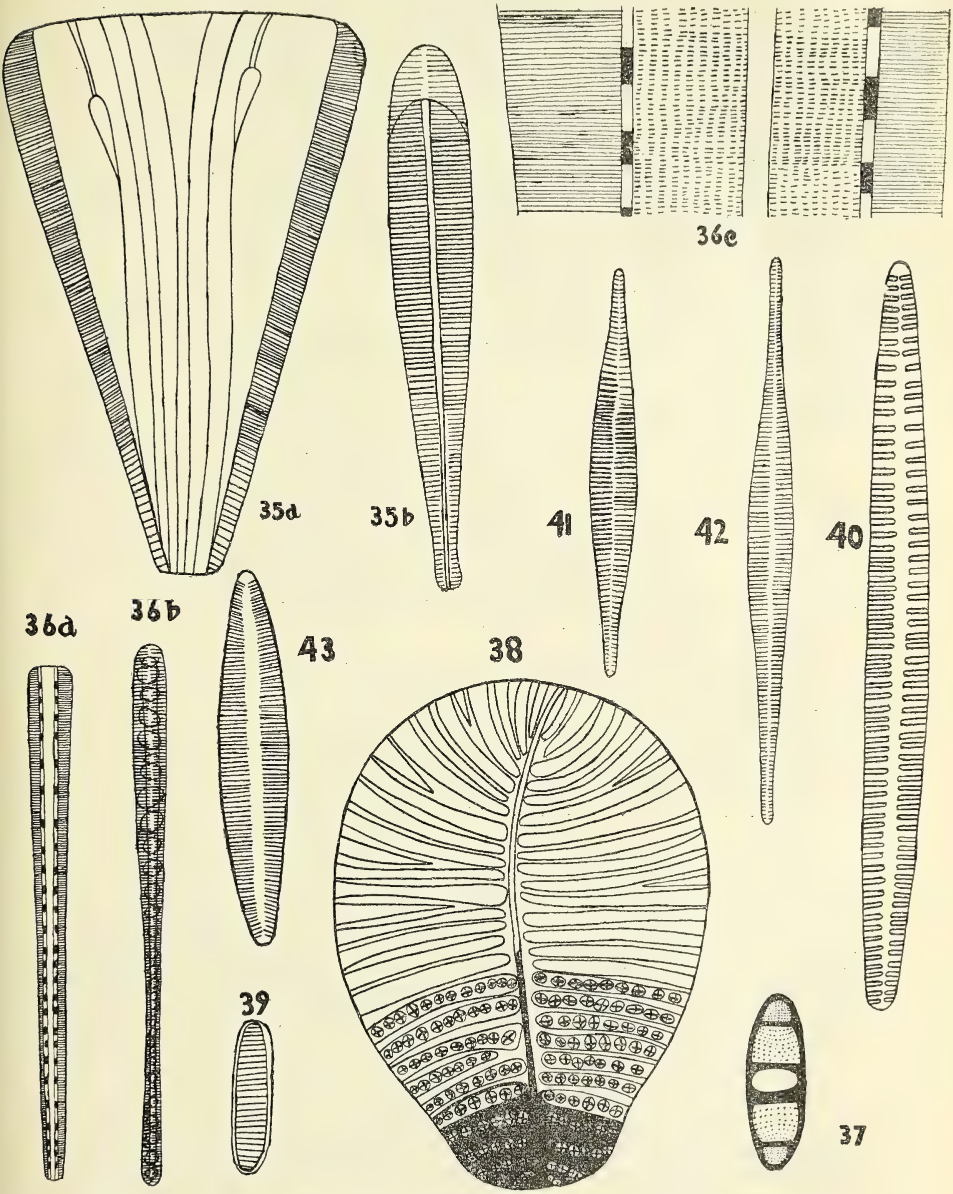
Long. frustule, 13–28μ.
Lat. frustule, 13–20μ.
Transapical striations on the epitheca, 6-10 in 10μ.
Punctae on the epitheca, 7–9 in 10μ.
Transapical striations on the hypotheca, 18 in 10μ.

The form closely resembles the type.

Habitat: Dwarka. Epiphytic on *Dictyota.*

43. **Cocconeis costata** Greg. Hustedt, op. cit., p. 332, fig. 785, 1931-32.

Frustules epiphytic on *Bryopsis*, hypotheca and epitheca similar, elliptic in outline. Epitheca with prominent radial transapical ribs or striations



Text-figs. 35-43. Figs. 35 a, b, *Licmophora communis* (Heib.) Grun. girdle- and valve-view. Fig. 36 a, b, *Climacosphenia littoralis* sp. nov. frustules in girdle- and valve-view, showing intercalary band and septa. Fig. 36 c, a part of the same, showing striations and punctae. Fig. 37, *Plagiogramma pulchellum* var. *intermedia* var. nov. valve-view. Fig. 38, *Podocystis ovalica* sp. nov. frustule in valve-view, showing areoled transapical striations. Fig. 39, frustule, showing striations. Fig. 40, *Synedra kashyapensis* sp. nov. frustule, showing striations. Fig. 41, *Synedra famelica* Kütz. frustule, showing striations. Fig. 42, *Synedra hyperborea* Grun. var. *rostellata* Grun. frustule with striations. Fig. 43, *Synedra tabulata* (Ag.) Kütz. var. *fasiculata* (Kütz.) Grun. frustule with striations. (35 a, b, X 1530 ; 36 a, b, X 700 ; 36 c, 37, 39, 40, 41, 42, 43, X 2800 ; 38, X 1400).

Interspaces between the striations distinctly areoled, areoles arranged in quincunx, pseudoraphe narrow, hyaline and linear. Hypotheca traversed by transapical striations, raphe straight, axial area very narrow, hyaline, margin with transverse bands (text-fig. 46).

Long. frustule, 18$\mu$.
Lat. frustule, 13$\mu$.
Transapical striations on the epitheca, 12 in 10$\mu$.
Punctae on the epitheca, 15 in 10$\mu$.
Transapical striations on the hypotheca, 12 in 10$\mu$.
Punctae on the hypotheca, 16 in 10$\mu$.

The form possesses larger number of striations than the type, otherwise closely agrees with it.

Habitat: Porbandar, Veraval. Epiphytic on *Bryopsis*.

44. **Cocconeis californica** Grun. Hustedt, op. cit., p. 343, fig. 796, 1931-32.

Frustules with hypotheca and epitheca similar in outline, but differing in punctations. Epitheca traversed by transapical punctae, striations radially arranged, punctae in slightly wavy lines. Pseudoraphe narrow, linear but slightly bulged in the middle. Hypotheca radially punctate. Punctae fine. Raphe straight, axial area narrow hyaline, central knot slightly bulged. Margin in the valves hyaline (text-fig. 47).

Long. frustule, 20-21$\mu$.
Lat. frustule, 12-17$\mu$.
Transapical striations on the epitheca, 10 in 10$\mu$.
Punctae on the epitheca, 9·12 in 10$\mu$.
Transapical striations on the hypotheca, 12 in 10$\mu$.
Punctae on the hypotheca, 11 in 10$\mu$.
The form closely resembles the type.
Habitat: Dwarka, Veraval. Epiphytic on *Bryopsis*.

45. **Cocconeis placentula** Ehrenb. var. **euglypta** (Ehrenb.) Hust. Hustedt, op. cit., p. 349, fig. 802 c, 1931–32.

Frustules with elliptical hypotheca and epitheca. Epitheca with radial punctate striations. Punctae in thick long row. Pseudoraphe narrow linear. Hypotheca with fine punctate transapical striae. Raphe thin linear, axial area narrow, central knot distinct (text-fig. 48).

Long. frustule, 18–21$\mu$.
Lat. frustule, 8-17$\mu$.
Transapical striations on the epitheca, 6 in 10$\mu$.
Punctae on the epitheca, 12–15 in 10$\mu$.
Transapical striations on the hypotheca, 6 in 10$\mu$.
Punctae on the hypotheca, 14 in 10$\mu$.

The form closely resembles the type.

Habitat: Dwarka. Epiphytic on *Chamaedoris*.

46. **Cocconeis dirupta** Greg. var. **flexella** (Jan. and Rabh.) Grun. Hustedt, op. cit., p. 354, figs. 809, d–i, 1931–32.

Frustules attached to *Gracilaria* thallus, both hypotheca and epitheca are elliptically broad. Epitheca with wavy, remote, radial transapical striae in an intercrossing system. Pseudoraphe lanceolate and broad pointed at the ends. Hypotheca with radial punctate transapical striations, raphe sigmoid, axial area narrow (text-fig. 49).

Long. frustule, 26–44$\mu$.
Lat. frustule, 15–17$\mu$.
Transapical striations on the epitheca, 12–18 in 10$\mu$.
Intersecting lines on the epitheca, 9–14 in 10$\mu$.
Transapical striations on the hypotheca, 15–20 in 10$\mu$.
Punctae on the hypotheca, 16–21 in 10$\mu$.

The form closely agrees with the type in its structure.

Habitat: Dwarka, Veraval. Epiphytic on *Gracilaria*.

47. **Cocconeis heteroides** Hantz. Hustedt, op. cit., p. 356, fig. 811, 1931–32.

Valves elliptic. Epitheca with fine radial transapical striations, narrow bow-shaped hyaline furrow between the striations. Pseudoraphe broad, linear, oblique at the ends. Hypotheca with tansapical striations, thicker towards the ends. Axial area hyaline. Raphe strongly sigmoid (text-fig. 50 a, b).

Long. frustule, 17–23$\mu$.
Lat. frustule, 14–16$\mu$.
Transapical striations on the epitheca, 28 in 10$\mu$.
Transapical striations on the hypotheca, 25–27 in 10$\mu$.

The form agrees well with the type.

Habitat: Dwarka, Porbandar. Epiphytic on *Valoniopsis*.

48. **Cocconeis quarnerensis** Grun. var. **borgesensis** var. nov.

Frustules elliptic lanceolate, epitheca with short radial striations touching the margin (marginal), central ones broad, lanceolate, with faint signs of striations. Pseudoraphe narrow, lanceolate. Hypotheca with strong radial striations. Raphe straight, axial area very narrow. Central area bulged and barrel-shaped (text-fig. 51).

Long. frustule, 23–42$\mu$.
Lat. frustule, 10–16$\mu$.
Transapical striations on the epitheca, 10 in 10$\mu$.
Transapical striations on the hypotheca, 10–12$\mu$.

The present diatom resembles *Cocconeis quarnerensis* Grun. (Hustedt, op. cit., p. 360, fig. 814, 1931–32) in having marginal transapical striations, and in its pseudoraphe being lanceolate, it further resembles the same on account of its central area being bulged. It, however, differs from the same in the possession of a barrel-shaped central area instead of the circular as in the type. Further, the transapical striations are greater in number.

Habitat: Okha Port. Epiphytic on *Ceramium*.

Accedit ad speciem typicam striis marginalibus transapicalibus, pseudoraphe lanceolata, area centrali tumescente. Differt vero ab ea centro doliiformi, striis transapicalibus pluribus.

49. **Cocconeis pelta** Schmidt. Hustedt. op. cit., p. 361, fig. 815, 1931–32.

Shell elliptical, epitheca with radial transapical striations, and broad irregularly punctate middle portion, hypotheca with transapical striations. Raphe straight, axial area narrow. Central area more or less round (text fig. 52).

Long. frustule, 31$\mu$.
Lat. frustule, 13$\mu$.
Transapical striations on the epitheca, 18 in 10$\mu$.
Transapical striations on the hypotheca, 20 in 10$\mu$.

The form closely resembling the type differs in having bigger frustules.

Habitat: Porbandar, Veraval. Epiphytic on *Bryopsis.*

50. **Achnanthes taeniata** Grun. Hustedt, op. cit. p. 382, fig. 828, 1931-32.

Frustules in bands. Valve elliptic-lanceolate with broad round ends. Transapical striations fine. Pseudoraphe distinct, linear, raphe straight and thin, axial area very narrow, central area absent (text-figs. 53 a, b).

Long. frustule, 26–52$\mu$.
Lat. frustule, 7–9$\mu$.
Striations, 20–25 in 10$\mu$.

The form resembles the type closely.

Habitat: Porbandar. In sediment.

51. **Achnanthes hauckiana** Grun. Hustedt, op. cit., p. 388, fig. 834, 1931-32.

Frustules occurring freely. Valve slightly elliptic to lanceolate with narrow ends, which are wedge-shaped. Pseudoraphe distinct, linear-lanceolate, raphe pinnate, axial area narrow, central nodule slightly broad, central area round. Transapical striation strong, slightly radial to almost straight (text-fig. 54).

Long. frustule, 46$\mu$.
Lat. frustule, 7$\mu$.
Striations, 12 in 10$\mu$.

The diatom seems to be enjoying a wide distribution. It is stated to be occurring in brackish-water as well as in hot springs and in the Arctic Coast of White Sea, op. cit., Hustedt, p. 289, 1931-32.

The form agrees well with the type.

Habitat: Dwarka. In sediment.

52. **Achnanthes coarctata** (Breb.) Grun. var. **elliptica** Krasske. Hustedt, op. cit., p, 420, figs. 872 d-e, 1931–32.

Valves linear elliptical with flat round ends, pseudoraphe narrow close to the shell margin. Striations extending in the middle portion of the valve, hypotheca with straight prominent raphe, striations slightly radial (text-fig. 55).

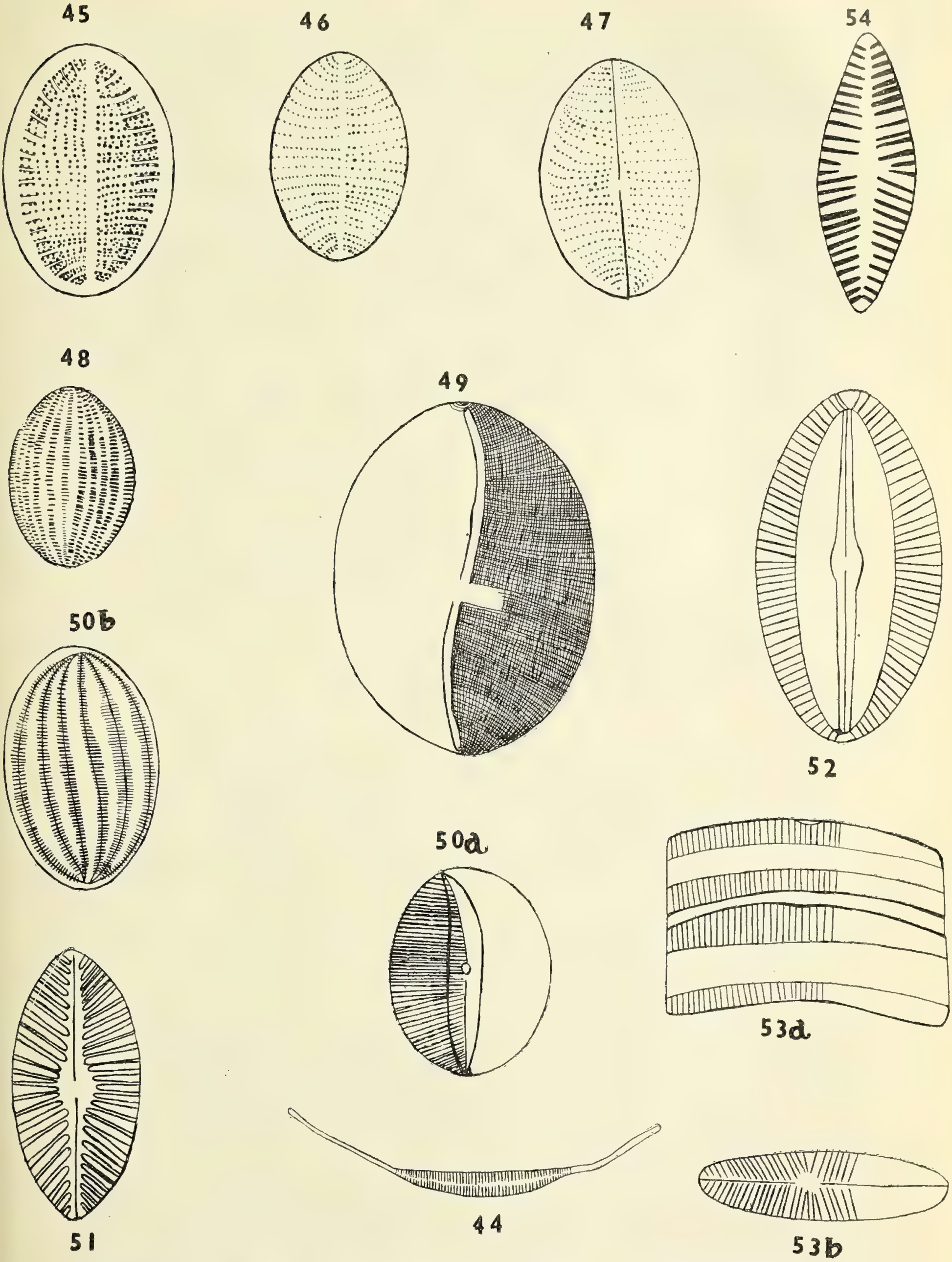
Long. frustule, 48–78$\mu$.
Lat. frustule, 8–12$\mu$.
Striations, 9 in 10$\mu$.

The form resembles *Achnanthes coarctata* (Breb.) Grun. var. *elliptica* Krasske, on account of possessing elliptic valve, in having radial striae, marginal pseudoraphe, and straight raphe. But it differs from the same in valves being longer and in having slightly wider striations.

Habitat: Porbandar. In sediment.

53. **Achnanthes arctica** Cleve. Hustedt, op. cit., p. 423, fig. 876, 1931–32.

Valves linear-elliptic with broad round ends and slightly concave sides. Pseudoraphe slightly wavy and narrow, central area absent. Striations vertical, arranged in more or less long wavy rows (text-fig. 56).



Text-figs. 44-54—Fig. 44, *Synedra closterioides* Grun., frustule, showing striations. Fig. 45, *Cocconeis clandestina* Schmidt., frustule with punctae. Fig. 46, *Cocconeis. costata* Greg. Fig. 47, *Cocconeis californica* Grun. Fig. 48, *Cocconeis placentula* Ehrenb. var *euglypta* Cleve. Fig. 49, *Cocconeis dirupta* Greg. var. *flexella* (Jan. and Rabh.) Grun. Fig 50 a, b, *Cocconeis heteroides* Haniz. Fig. 51, *Cocconeis quarnerensis* Grun. var. *börgesensis* var nov. frustule, showing radial striations. Fig. 52, *Cocconeis pelta* Schmidt. Figs. 53, a, b, *Achnanthes taeniata* Grun., frustules with striations. Fig. 54, *Achnanthes hauckiana* Grun., frustule, showing striations. (All X 2800).

Long. frustule, 40–46μ.
Lat. frustule, 7–11μ.
Striations, 15 in 10μ.

The form agrees well with the type.

Habitat: Bombay. In sediment.

54. **Achnanthes brevipes** Ag., var. **intermedia** (Kütz.) Cleve. Hustedt op. cit., p. 425, figs. 877 d, e, 1931–32.

Valves linear-lanceolate with round ends. Narrow pseudoraphe., Striations straight and prominent (text-fig. 57).

Long. frustule, 38–45μ.
Lat. frustule, 10–15μ.
Striations, 9–10 in 10μ.

The Indian diatom closely resembles the type.

Habitat: Dwarka, Okha Port. In sediment.

55. **Rhoicosphenia marina** (Smith) Schmidt. Hustedt, op. cit., p. 432, fig. 880, 1931–32.

Shell club-shaped with broad round apex, basal pole narrow, transapical striations prominent, straight. Raphe straight extending almost to the middle of the frustule. Pseudosepta present (text-fig. 58).

Long. frustule, 13–15μ.
Lat. frustule, 3–5μ.
Striations, 20 in 10μ

The form closely resembles the type.

Habitat: Okha Port, Dwarka. In sediment.

56. **Diploneis incurvata** (Greg.) Cleve, var. **arabica** var. nov.

Valves linear-elliptic, constricted in the middle, with round ends, central nodule moderately small, almost quadratic in outline. Horns distinct, parallel, furrows broad. Transapical striations straight and well-developed, on the poles radial, outer wall striated. Alveoli absent (text-fig. 59).

Long. frustule, 42–52μ.
Lat. frustule in the middle, 10–13μ.
Lat. frustule in the upper part, 17–20μ.
Striations, 10–12 in 10μ.

Though the Indian diatom resembles *Diploneis incurvata* (Greg.) Cleve., (Hustedt, op. cit., p. 593, figs. b–d, 1937) in general structure, but it differs from the same in possessing well-developed striations. The Indian variety further varies from the same in the absence of alveoli.

Ad varietatem typicam accedit multis in notis; differt vero striis bene definitis, absentia alveolorum.

57. **Diploneis confecta** (A. S.) Hust. Hustedt, op. cit., p. 609, figs. 1023 a, b, 1937.

Valve linear-elliptic, constricted in the middle with round ends. Central nodule long, quadratic in outline, apex rectangular, horns parallel and strong. Raphe furrow broad, striations long, narrow, interrupted in the middle, radially arranged in the lower portion, furrow region poroide (text-fig. 60).

Long. frustule, 52–58$\mu$.
Lat. frustule in the middle, 11–13$\mu$,
Lat. frustule in the upper portion, 16–18$\mu$.
Striations, 7–8 in 10$\mu$.

The form closely resembles the type.

Habitat: Okha Port. In sediment.

58. **Diploneis crabro** Ehrenb. forma **suspecta** (A. S.) Hust. Hustedt, op. cit., p. 620, fig. 1029 b, 1937.

Valves linear-elliptic, ends wedged (acute) round, constricted in the middle. Central nodule elongated quadrate in outline, horns strong, parallel. Striations strong, radial. Raphe furrow broad. Outer wall poroide (text-fig. 61).

Long. frustule, 52$\mu$.
Lat. frustule in the middle, 13$\mu$.
Lat. frustule in the upper part, 18–20$\mu$.
Striations, 7 in 10$\mu$.

The form closely resembles the type form.

Habitat: Dwarka. In sediment.

59. **Diploneis ovalis** (Hilse) Cleve, var. **oblongella** (Naeg.) Cleve. Hustedt, op. cit., p. 671, figs. 1065 f–k, 1937.

Valves broad elliptic, with broad round ends, central nodule very big, roundish-oblong in outline. Horns strong, parallel. Raphe furrow very narrow. Striations more or less prominent, distinctly radial, loculi indistinct, outer wall poroide (text-fig. 62).

Long. frustule, 40–43$\mu$.
Lat. frustule, 11–13$\mu$.
Striations, 15 in 10$\mu$.

The Indian diatom agrees well with the type.

Habitat: Porbandar, Veraval. The form occurs in sediment.

60. **Diploneis peterseni** Hust. Hustedt, op. cit., p. 676, figs. 1068 f–h, 1937.

Valves linear-elliptic, with broad round ends and slightly convex sides. Central nodule elongated, raphe furrow narrow, lanceolate. Striations fine, straight, loculi wall finely poroide (text-fig. 63).

Long. frustule, 22–26$\mu$.
Lat. frustule, 6–8$\mu$.
Striations, 20–24 in 10$\mu$.

The form closely resembles the type.

Habitat: Dwarka, Bombay. In sediment.

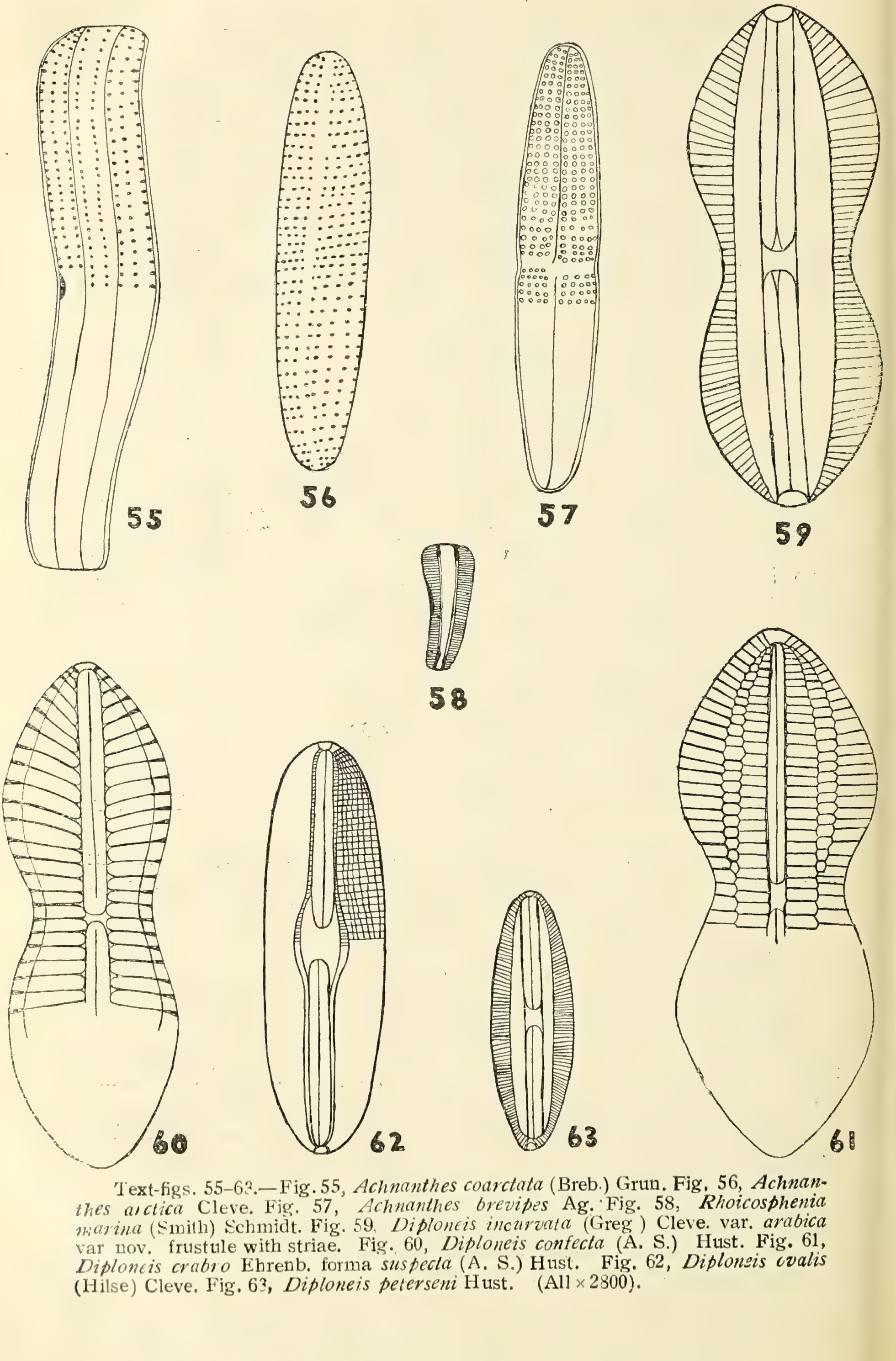
61. **Pinnularia directa** Smith. Smith, A synopsis of the British Diatomaceae, Vol. 1, London, p. 56, pl. xviii, fig. 172 b, 1853.

Frustules in girdle-view rectangular with round ends. Striations fine, straight and parallel (text-fig. 64).

Long. frustule, 39–40$\mu$.
Lat. frustule, 9–13$\mu$.
Striations, 20 in 10$\mu$.

The Indian diatom closely resembles the type.

Habitat: Dwarka, Bombay. In sediment.



Text-figs. 55–63.—Fig. 55, *Achnanthes coarctata* (Breb.) Grun. Fig, 56, *Achnanthes arctica* Cleve. Fig. 57, *Achnanthes brevipes* Ag. Fig. 58, *Rhoicosphenia marina* (Smith) Schmidt. Fig. 59, *Diploneis incurvata* (Greg.) Cleve. var. *arabica* var nov. frustule with striae. Fig. 60, *Diploneis confecta* (A. S.) Hust. Fig. 61, *Diploneis crabro* Ehrenb. forma *suspecta* (A. S.) Hust. Fig. 62, *Diploneis ovalis* (Hilse) Cleve. Fig. 63, *Diploneis peterseni* Hust. (All × 2800).

62. **Pleurosigma nubecula** Smith. Smith, op. cit., Vol. 1, p. 64, pl. xxi, fig. 201, 1853.

Valves linear-lanceolate, very slightly sigmoid, ends obtuse, striations oblique, intercrossing, central raphe slightly sigmoid. Central area small, oblong (text-fig. 65).

Long. frustule, 90--144$\mu$.
Lat. frustule, 18–26$\mu$.
Striations, 20 in 10$\mu$.

The Indian form agrees well with the type.

Habitat: Dwarka, Bombay. In sediment.

63. **Pleurosigma strigosum** Smith. Smith, op. cit., Vol. 1, p. 64, pl. xxi, fig. 203, 1853.

Valve lanceolate to sigmoid with obtuse ends, raphe central, narrow and sigmoid, central area narrow, round. Striations oblique intercrossing, punctate (text-fig. 66).

Long. frustule, 200–221$\mu$.
Lat. frustule, 30–33$\mu$.
Striations, 12–15 in 10$\mu$.

The form agrees closely with the type.

Habitat: Bombay. In sediment.

64. **Amphora holsatica** Hust. Hustedt, Pasher's Susswasser-Flora, Heft 10, p. 345, fig. 633, 1930a.

Frustules occurring freely, valves lunate with round ends, dorsal side slightly concave. Raphe straight, parallel to the concave or ventral side. Axial area narrow, towards the dorsal side. Transapical striations radial punctate. Punctae big and round (text-fig. 67).

Long. frustule, 36–39$\mu$.
Lat. frustule, 6–8$\mu$.
Striations, 12–14 in 10$\mu$.
Punctae, 12 in 0$\mu$.

The form agrees well with the type, except that the ventral side is slightly concave instead of being straight.

Habitat: Bombay. In sediment.

65. **Amphora caffeaeformis** Ag. var. **africana.** Fritsch et Rich, Trans. Roy. Soc. S. Africa, Vol. XVIII, pt. 2, p. 112, figs. 8 a-d, 1930.

Valves lunate, with the dorsal side convex, the ventral side is straight or slightly arched, ends elongated and capitate, striae fine and radial, axial area narrow. Raphe straight (text-fig. 68).

Long. frustule, 22–26$\mu$.
Lat. frustule, 3–4$\mu$.
Striations, 15–17 in 10$\mu$.

The form agrees well with the varietal type.

Habitat: Dwarka. In sediment.

66. **Amphora salina** Smith. Smith, op. cit., Vol. I, p. 19, pl. xxx, fig. 251, 1853.

Frustule in the girdle-view elliptic truncate. Ends slightly produced and round. Striations straight and fine (text-fig. 69).

Long. frustule, 15–17$\mu$.
Lat. frustule, 6–7$\mu$.
Striations, 15 in 10$\mu$.

The form closely resembles the type.

Habitat: Okha Port. In sediment.

67. **Amphora costata** Smith, op. cit., Vol. I, p. 20, fig. 253, 1853.

Frustules ellipsoidal, in girdle-view longitudinally striated, with straight striae. Ends produced and round (text-fig. 70).

Long. frustule, 30–33$\mu$.
Lat. frustule, 18–20$\mu$.
Striations, 15 in 10$\mu$.

The form closely resembles the type.

Habitat: Okha Port. In sediment.

68. **Bacillaria paradoxa** Gmelin. Smith, op. cit., Vol. II, p. 10, pl. xxxvii, fig. 279, 1853.

Valves linear, spindle-shaped, with a row of carinal dots situated in the middle portion of the valves. Transapical striations extremely fine, straight throughout (text-fig. 71).

Long. frustule, 68–75$\mu$.
Lat. frustule, 6–7$\mu$.
Striations, 24–28 in 10$\mu$.
Carinal dots, 8–9 in 10$\mu$.

The Indian diatom closely agrees with the type.

Habitat: Porbandar, Veraval. In sediment.

69. **Nitzschia sigma** Smith. Smith, op. cit., Vol. I, p. 39, pl. xiii, fig. 108. 1853.

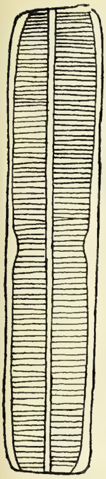
Valves lanceolate, sigmoid, gradually tapering towards the truncate ends. Striations finely punctate, punctae in double row (text-fig. 72).

Long. frustule, 52—60 $\mu$.
Lat. frustule, 5—6 $\mu$.
Striations, 8 in 10 $\mu$.
Punctae, 16 in 10 $\mu$.

The form agrees well with the type.

Habitat: Dwarka. In sediment.

The present investigation comprises a study of 69 forms of littoral benthic diatoms belonging to Okha Port, Dwarka, Porbandar, Veraval and Bombay on the West Coast of India. Out of the total forms enumerated above, 45 are found to be epiphytic on the various higher algae; the rest, that is, 24 occur in the sediment. Amongst the three classes of algae, that is Chlorophyceae, Phaeophyceae and Rhodophyceae, the members of the Chlorophyceae harbour the largest number of epiphytes and *Cladophora* amongst these constitutes the most accommodating host. Thus, as mentioned in the habitat of each form, 5 members of the Centrales and 3 of the Pennales are found epiphytic on *Cladophora*. This preference of the Chlorophyceae by a large number of the diatoms seems to be mainly due to the similar ecological conditions suitable to their chlorophycean hosts. The occurrence of the hosts in any one of the above places is in the protected localities of the intertidal region, like pools and puddles.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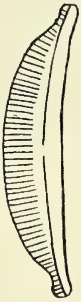
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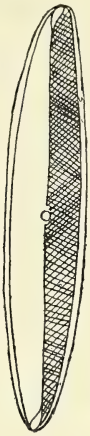
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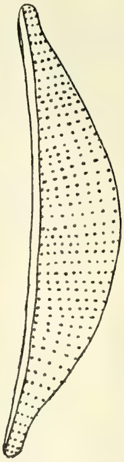
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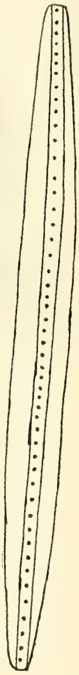
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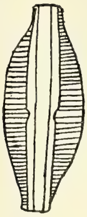
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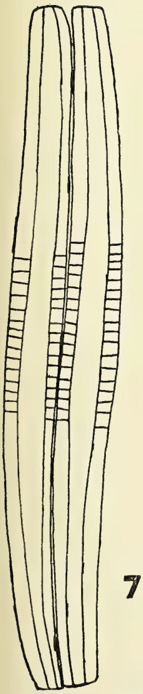
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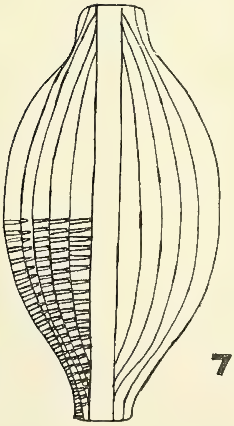
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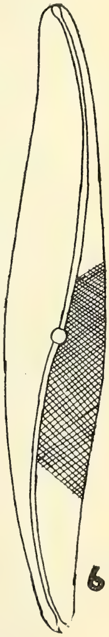
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Text-figs. 64—72.—Fig. 64, *Pinnularia directa* Smith. Fig. 65, *Pleurosigma nubecula* Smith. Fig. 66, *Pleurosigma strigosum* Smith. Fig. 67, *Amphora holsatica* Hust. Fig. 68, *Amphora caffeaeformis* Ag. var. *africana* Fritsch et Rich. Fig. 70, *Amphora salina* Smith. Fig. 71, *Bacillaria paradoxa* Gmelin. Fig. 72, *Nitzschia sigma* Smith. (66 × 790 ; rest × 2,800).

In view of the present observations it is interesting to note that the same host when growing in exposed localities, does not bear any epiphytic form. In respect of the epiphytic nature of the two groups of diatoms, there appears a more or less balance. However, the Pennales show greater epiphytism than the Centrales because out of the 45 epiphytes, only 20 belong to the Centrales, while 25 are Pennales. The study of the diatoms present in the sediment indicates absence of centric diatoms.

In conclusion, the author expresses his great indebtedness to Prof. Y. Bhâradwâja for his kind guidance and criticism throughout the course of this investigation.

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# THE WHITEBELLIED SEA EAGLES OF KARWAR [*HALIAËTUS LEUCOGASTER* (*GMELIN*)]

BY

R. S. Dharmakumarsinhji

AND

K. S. Lavkumar

(*With two plates*)

## PART I

BY R. S. D.

I was at Karwar on inspection duty from December 20 to 22, 1955, a place that I would call one of the most beautiful coasts of India. Karwar itself is a small port, situated on the western coast of India, 14° 49′ N. and 74° 8′ E., with a population of about 78,700. There is a beautiful harbour surrounded by evergreen forest, thickly wooded with trees and a great variety of fauna and flora. I was staying with a friend Shri D. V. Narurkar, Sub-Divisional Forest Officer, Western Kanara Forest Division, Honavar, who showed me round the town, the adjoining forest area, and the beach between the harbour of Karwar and the mouth of the Kali Nadi. It is here that many of the fishing boats land their catches and also the fishermen drag their nets in the shallow waters for 'Bangda' and other small fish. And it was at this beach that I saw groups of 40 to 50 Brownheaded Gulls in winter plumage. They were so tame as to permit me to approach within 30 or 40 ft. and, when the fish were caught, they would all fly at a few feet above our heads. What surprised me was that even Common Kites joined in the melee and were almost touching the Gulls without causing any alarm.

The green wooded hills as a background to the white sands of the beaches, and the blue sea with sailing boats in the foreground, seen from a country craft, makes a superb tableau difficult to compare with any other part of the world. I was sailing in a fishing boat, heading towards the lighthouse on Deogad island, also known as Oyster Rock, 10 miles away from Kodibag. Kodibag is a small landing place and a harbour for 'dhows' on the Karwar side, at the mouth of the Kali Nadi. Across the river, the conspicuous white dome of the temple at Sadashivgadh could be clearly seen about a mile away. My arrival at Karwar had been from this side, over Anshi Ghat, and I had crossed by a ferry to the small landing jetty at Kodibag. Now, I was in a 'machwa'—a medium sized fishing boat—sailing silently but speedily over the sea to the lighthouse at Deogad. The east wind filled the sails and we crossed the bay as we sped to our destination. There was a slight swell, caused by the strong east wind which made the white horses fret. The sun was bright but pleasant as the air was cold. Many Brownheaded Gulls were seen flying singly, but the spectacular performances of the Lesser and Large Crested Sea Terns, diving perpendicularly into the water and submerging for a second or two after their prey—small fishes—were most exciting to watch. There did not appear to be a large variety of sea birds at this time. On our return, we passed two islands, Kuramgad and Mudlingad, which means middle island; the first is well clothed with trees such as coconut palms and mango, and the second is well wooded and an abode of large and small birds. In half an hour we reached Deogad. Close to this island there is an islet covered with thick vegetation, and in the strait which divides this islet and Deogad we came slowly to a stop and, then, as the water was not very deep we punted our way to the landing of cobbled stones where red crabs and oysters were clinging to the rocks. My guide on this trip was Shri M. A. Gokarna, the Range Forest Officer, Karwar, who knew the head lighthouse-keeper fairly well. We disembarked and walked up the steps to the hill-top where we were greeted by the keeper himself, Shri B. J. Noronha, who welcomed us to his house. Mr. Noronha is a short, thin and rather frail-looking man of middle age, and I wondered how he could weather the seas and storms. My doubts, however, were soon to be removed, for while inspecting the surrounding islands I found him to be as nimble as a monkey and as sure-footed as an ibex. I saw him jumping from rock to rock and climbing down steep rocky crags and up again. He knew every bit of the islands around Deogad, and Deogad itself, but this was not all. He knew all the common animals and birds existing on the island although he was not quite aware of their names. As I introduced myself and listened attentively to his experiences at fishing and his acquaintance with the natural fauna of the islands, I was learning something from an intelligent man who had carefully observed the movements of bird and animal life of the surroundings. He was a Robinson Crusoe, but with a large family of seven children. His hospitable wife looked after me during my sojourn on the island. As we were talking of birds, a big grey bird floated past and I immediately guessed it to be a sea eagle. I watched it for some minutes as it slowly soared higher and higher, keeping its wings well above the horizontal, in a wide 'V' shape. The broad black border to the white under-wing, ash-brown upper parts and the black wedge-shaped tail broadly tipped with white gave me an indication that it was a Whitebellied Sea Eagle. I immediately recalled the 'Birds of Travancore-Cochin' by Sálim Ali, in which the description of this eagle fitted the bird perfectly. As I watched the bird, I felt there was no doubt regarding my identification and I audibly mentioned the Whitebellied Sea Eagle. No sooner had I uttered the name, Mr. Noronha told me with nonchalance that the bird had been breeding on the island since the past few years. My observation of this species was merely confined to the bird I had seen in Saurashtra many many years ago, and I was completely unaware of the habits and behaviour of this majestic sea eagle, other than what I had recently read in an article by Loke Wan-Tho, the renowned Malayan ornithologist, in the *Journal*, Vol. 50 No. 3. The first impression I got of the bird when I saw it from below was that of a pelican without its long bill, and then, when I had watched the bird a number of times when it was flying in the same horizontal line as my eyes, it gave me the impression of a gigantic Blackwinged Kite, particularly because of the short white-tipped tail which could not be seen to be wedge-shaped from a great distance, and the manner in which it held its wings. Mr. Noronha took me up the lighthouse and I was admiring the beautiful seascape with all the different islands along the shore some miles out at sea. It gave me a reminiscent touch of the Scandinavian coast and its Fjords. I used my binoculars and looked across on the north-western side, focussing on an islet with steep rocks and boulders and with a few stunted trees clinging on to the little soil that had been preserved by a narrow top layer of grass. There I discovered a nest of the sea eagle and I could see a bird standing over the nest. The excitement was great, for I wondered what was inside the nest. Was the bird breeding? I spoke to Mr. Noronha and we decided to paddle up to this little island after lunch in his small fishing boat. Now I was most interested, and soon we were on our way to the islet which, at its nearest portion to Deogad, was only about 250 yards away. Since the boat house was further away we had to paddle about half a mile to reach the beach-head where we could land without colliding with the large out-cropping of rocks that shielded the islet. Mr. Gokarna had joined us on this trip, and after landing we soon made our way to a point opposite the nest. At this point we were almost level with the nest, though slightly lower. As soon as I aimed my cine-camera lens towards the bird which was sitting on the nest, she flew off and revealed to me two young eaglets in white downy coats. The larger of the two had some brown feathers on the scapula and neck, but the other was completely white. As soon as we had shown ourselves the parent bird started flying over our heads and crying vigorously in a characteristic *Kyānk—Kyānk*. She would not leave us for some time; then she flew out towards the sea and again returned with her mate. Now both the birds were flying over us though well apart, and then one, which I considered to be the male, flew out of sight. I watched the other bird and was most impressed by the magnificent style in which she was gliding and soaring. She would catch the wind currents and soar in circles rising rapidly and I could see that the wide 'V' shape angle helped her considerably in gaining height. The remarkable way in which she could do this can only be compared with birds I have seen soaring in similar manner such as the Blackwinged Kite, Pale Harrier, Short-toed Eagle, and, to some extent, Buzzards and Tawny Eagles. But this bird, of all, seemed to me really outstanding. For a long time I watched her closely, catching the air currents and rising rapidly into the sky in wide circles. Soon after we had reached the top we flushed a large Monitor Lizard which ran down the grassy slope and over the rocks, till almost into the sea, and disappeared among some crevices. If only the eagle had dived down it would have made a superb picture but it appears that these eagles were disturbed by our visit, besides being partial to marine life for their food. Since time was short and I had to leave for other work I was obliged to return to the lighthouse and then proceed to the mainland. I talked to Mr. Noronha, requesting him to cooperate by assisting a friend of mine, who might like to come here on a bird expedition to photograph the sea eagles at their nest. Mr. Noronha cordially acquiesced in my plans and I had no difficulty in persuading my friend Shri K. S. Lavkumar to visit the island. His interesting story of a week spent in what I have called the 'Kankan' expedition follows. 'Kankan' is the local and appropriate name of the sea eagle, derived from its call, and I have named the nest islet, 'Kankan'. Another islet close-by, when seen from 'Kankan' islet, looks exactly like a submarine without its periscope, and this may aptly be called 'Submarine' islet! I hope these names will be accepted as appropriate.

## PART II

### BY K. S. L.

On January 12, 1956 I embarked at Bombay on my first sea voyage with much misgiving regarding my capabilities as a sailor. But finding no increase in the rolling of the ship as the twinkling lights of Bombay receded in our wake, I cautiously began to enjoy the cool breeze in the face and the rush of the sea alongside the ship. Superstitiously I touched wood to ensure against some sudden storm.

I was up early the following morning to watch a tall-sailed dhow ride past against a watery dawn. Immediately the sun's first rays struck the water, the grey of the sea blazed up into shimmering gold that changed to a blue challenging the clear winter sky overhead. But the colour was never the same for long, often and evanescent green crept over to become a rich brown as we passed over beds of aquatic weeds. White-sailed dhows strung the entire coast faintly visible eight miles to the east.

Surprisingly the first living thing I saw, apart from man and his manifestations, was a butterfly, the common black variety of our gardens. I saw many of these frail things battling against air currents that carried them further and further to their doom. Schools of porpoises splashed past all seemingly headed north. Brownheaded Gulls fed on the surface singly and in small parties. Blackheaded Gulls were less in evidence. Yellowbilled Crested Terns flew buoyantly above, plunging now and then in headlong dives after shoals of surfacing fish.

The morning so uneventful to seasoned voyagers passed only too quickly for me. At 2.00 p.m. the headland of Karwar was sighted. The shore, now closer, had changed considerably and high wooded hills came out to meet the sea in rocky capes and islands. Forest grew down to the very edge of rocks denuded by the rough monsoon seas. Fine sweeps of sand bordered the bay, and stands of Casuarinas added a temperate charm to this coconut fringed coast. North of the bay were the two large islands of Kurrumgadh and Mudlingadh. Out to the north-west lay the Oyster Rocks, islands with the lighthouse where I was to spend most of my stay.

January 14 being the Hindu day of Sankrant, local belief cautioned me against going what was termed 'overseas', and I had to pass the day idling along the beaches watching fishermen mending nets and Brownheaded Gulls along the edge of the waves or Lesser Sand-plovers among sand-binding *Ipomoea biloba;* on spray wetted rocks Common Sandpipers twittered while Common Kingfishers plunged after multi coloured fish in tide-left rock-pools. In the afternoon I lay in the balmy water of Cemetery Bay listening to sweet warbles of a Blue Rock Thrush or gazing at a Whitebellied Sea Eagle high up in the heavens.

Describing the bird to the proprietor of Grand Hotel, where I stayed while in Karwar, I was agitated when he recognized the bird as being a favourite dish among some of the locals. There was no reason to suppose that Mr. D'Souza was mistaken, for he had been an active companion to many European naturalists during their visit to Karwar after butterflies and deep sea fish. I did, however, muster all possible doubt when he imitated the call, sounding very like a Black Ibis, and when he said that the bird was called 'Kankan' by the fisher folk. In Saurashtra the Black Ibis is known as the Kankan. To be ignorant is to be happy as I learnt a couple of days later when I heard my birds call like Black Ibis and the lighthouse lascars call them Kankans! My fears, allayed through ignorance, were removed when the lighthouse-keeper Mr. Noronha, my host on the islands, told me later in the evening that he had been to the eyrie and that the eaglets were safe.

On the 15th morning Mr. Gokarna picked me up in a car and drove me eight miles to the Kodibag ferry where a country craft had been hired to take me and my equipment out to the lighthouse. It being a Sunday, the entire Forest Office staff accompanied us to the islands for a picnic, and we had a very merry morning indeed.

Only after they had returned to the mainland, sails straining to a brisk afternoon sea-breeze, was I able to turn to the task in hand and, following an introduction to Mr. Noronha's charming wife and children, we sat down over a cup of tea to plan the strategy for photographing the eagles.

It was decided to set up the hide that very evening and observe the birds' reactions to it. Should they seem to pay no extra heed to this new structure on the crag opposite them, I was to spend the 16th night on the eagle islet so as to be in the hide early to get most out of the morning light which alone was suitable for photography and observation. The afternoon sun set up strong reflections in the sea backlighting the birds in shadowy relief.

Landing on the islet was a tricky business as it had to be done on sea-swept rocks from the heaving boat. Thick beds of edible oysters encrusted the rocks, giving some measure of hold to shod feet but naked feet had to be placed with great care; oyster shells can give nasty cuts. This islet consists of bare rocks rising some fifty feet from the sea in two crags fifty yards apart. The very top, where the monsoon waves cannot reach, is a thick mass of stunted trees, thorn shrubs and wild plantains. The western and narrower pinnacle is a little higher, and the eyrie was situated right on its top. The hide was placed on the other cliff opposite the eyrie, among low shrubs that provided a very useful camouflage. The only drawback was that the inside of the nest was not visible, so that when the eaglets were crouching on the far end, they could not be seen. The distance also was a little too far even for the 300 mm. tele-lens. However, for observations one could ask for nothing better, considering how nature had provided a derrick for the hide, a thing necessary when photographing this bird, which normally builds on the tallest trees in the area [see W. T. Loke's article *JBNHS*, 50 (3)]. All previous observers mention tall trees as the usual sites for nests. In 'Nidification of Indian Birds' Stuart Baker writes: 'Sometimes the birds make their nest on very small islands, just a few rocks with a scanty scrub growth and a few large trees', but he does not go on to clarify whether these large trees are invariably used or nests are placed on inaccessible rocks themselves. According to him large trees in the centre of villages are also used, the birds losing all fear of man and paying no heed to his activities.

Looking from the base of the cliff, the nest appeared to be empty and, fearing the worst, I scrambled to where the hide was to be placed. To our relief the eaglets, two in number and fully fledged, were crouching in the nest sheltering from a strong wind blowing in from the sea. Both Stuart Baker and Jerdon mention two to be the usual number of the clutch, but Mr. Loke found the bird he photographed incubating only one egg. As this turned out to be addled, there is a possibility there was something wrong with the hen.

While the scrub was being cleared and the hide erected, the parents circled over several times uttering an anxious *Keynch* from time to time finally leaving the vicinity of the islet altogether. I was struck by the great expanse of their wings which they flapped very seldom, holding them in a wide V over their backs and rising in great circles with effortless grace. In general form they looked very like Black-winged Kites at a distance, but overhead their pelican-like colouration and their wedge-shaped tails were pointers to an unmistakeable identity.

There being still ample light, we scrambled up to the eyrie to take a few closeups of the eaglets in their nest. On a platform some seven feet below the nest were strewn pieces of skin and bones of sea snakes. Perhaps because I appeared over the edge of the nest the eaglets sprang up and ran to the other edge with wings spread, the larger of the two becoming airborne. The second chick failing courage sank down on the very rim, where it lay still all the while we were on the eyrie. The first eaglet now assuming the dimensions of a Tawny Eagle carried on straight ahead and, being on its trial flight, could not turn to the rocks below but sailed into the wind, sinking lower and lower till it struck the water a mere speck among the waves. The only hope was to get the boat round to rescue it before it became too waterlogged to float or came to grief on the rocks. Mr. Noronha scrambled down for the boat while I remained on top to guide him. As the light was fast fading I took a hasty picture of the remaining bird. Turning round I found I had lost the bird in the water. The boat had only just left the island and I cursed myself for not having brought the binoculars with me. Just when I was giving the whole thing up as lost, a speck appeared in the glare set up by the setting sun. A strong current was bearing it to the east of the island into the narrow strait that lay between it and the main island. As the disc of the sun touched the water, the rescue was completed and I started my difficult descent. It was impossible to take the truant up to his home in the dark and, fearing that our second appearance at the eyrie might send the other chick in flight, we took him along with us to the lighthouse, where he was adopted by the children and soon became very tame taking fish proffered to him. He is now in the collection of His Highness the Maharaja of Baroda who finds him a charming pet. Should he survive to attain full maturity, he will provide a tremendous opportunity to study the moulting of the juvenile plumage in this species.[1]

Through field glasses it was possible to observe the birds clearly from the western end of the main island. The hide apparently caused no worry to the parents, and they visited the remaining chick with utter unconcern. Once both the parents came to the nest together but usually only one did so. The birds spent most of the morning in the shade of overhanging trees on the eastern end of the island. A third bird flew in from the sea to be attacked by the owners of the eyrie uttering a loud and defiant *kyank kyank kyank* . . . After driving the intruder off, the victors circled around majestically calling to each other in a Black Ibis *kenk kenk kenk* . . . Their great pinions were long in proportion, very unlike the broad square-tipped wings of other eagles, and seemed ideally suited for gliding, an art they appeared to have perfected above all other great raptors. They seemed to know the value of each cliff for air currents to rise effortlessly without any perceptible motion of the wings, and brought to mind the lämmergeier vulture of the Himalayas. But the speed of the rise at almost perpendicular inclines was phenomenal. To watch them glide along the crest of the waves, along a cliff and high up into the heavens above, made one doubt the universality of the law of gravity.

From my vantage point I saw that the Oyster Rocks were divided between two pairs of sea eagles, the second pair having its stronghold on the wooded island opposite the light boathouse. Their territories met over the light and we witnessed many aerial battles from the bungalow. Ten miles off Honaver, on Pigeon Island, Jerdon writes of a colony of 30 nests all on large trees. This island is used by the Navy for shelling practice, and this community must now be a thing of the past.

Though these eagles showed such resentment against their own kind they never seemed to molest other birds of prey. I saw a Longlegged Buzzard on the rocks on the lookout for crabs; a shikra that was constructing a nest in one of the banyans often shared the sky with them and an osprey, using the same vantage points as they. Contrary to Jerdon's observations I never saw them attempting to wrest away prey from the osprey, though the latter would be floundering heavily with some large fish and entirely at their mercy. Only once did a Brahminy Kite find itself at the receiving end of a power dive, when it approached too close to the eyrie.

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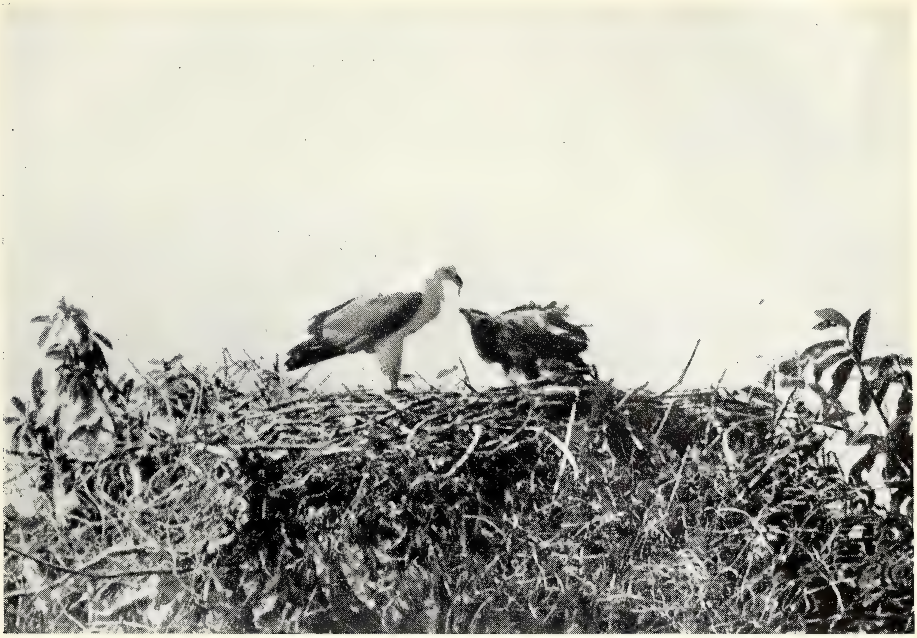
[1] A month later he was seriously mauled by a panther cub and died.

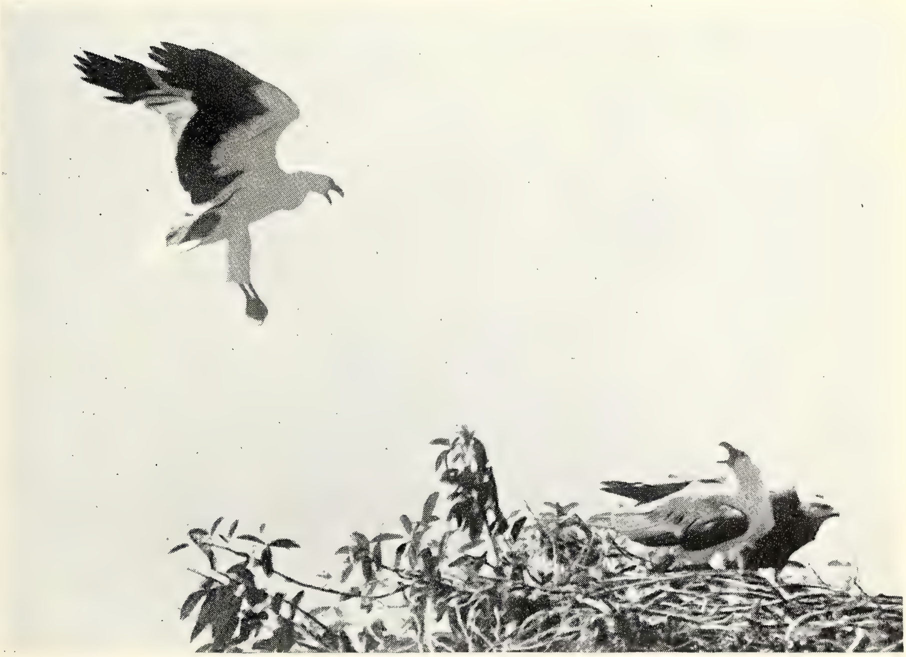
There were many other birds on the main island: Indian Orioles flashed from tree to tree, Whitebreasted Kingfishers dodged among the boulders, occasional willow-warblers flitted in the undergrowth, while a pair of wary House Crows nervously flew off when glanced at, no doubt feeling guilty at having stolen some stray hen's egg. Blue Rock pigeons bred in the cliffs, flighting to the mainland to feed. Blue Rock-thrushes were very common, one perching on the wind vane atop the light. On the wooded island I saw a Little Green Heron and a heronry of Reef Herons right in the centre of the island. Over the oyster encrusted rocks nimble Turnstones followed the waves to pick up stranded food, while Common Sandpipers were scattered singly along the shore and a group of four Whimbrel led a shy life on the extremities of Eagle Islet. Once a party of Redrumped Swallows sailed over. Mr. Noronha told me that Flying Fox flew out from the mainland to feed on the ripe banyan figs but apart from the friendly lighthouse dog, the only other mammals I saw were an otter fishing at the edge of the surf, and numerous porpoises in the sea around. Small brown lizards were fairly common both in the grass and on the rocks above the tide. A monitor lizard scampered into the undergrowth at my approach on the wooded island. Snakes I was told were fairly plentiful on the islands of Kurrumgadh and Mudlingadh. These are swept down by the Kali River during the monsoon deluges and swim on to these islands near the estuary of the river. In years to come Oyster Rocks will no doubt be colonised by their first serpent, ending for ever the days when one could walk anywhere bare-footed and in the dark. Small red ants swarmed on the eagle islet and a few mosquitoes hummed after dusk. Flies were absent.

Seeing that the eagles took no heed of the hide, I had myself rowed across to the islet on the 16th evening and spent the night outside the hide, to crawl in a little before dawn at 6.30 a.m. The eaglet was lying down. The parent arrived at 8.30 with something in its talons which I could not identify. Apparently the chick was not hungry for it evinced no response. The adult calling several times with neck outstretched, left the nest after a few minutes to return again at 9.00 with a sea snake dangling from its talons. The second parent joined it, both calling loudly in their typical clanging note. When together, it was possible to notice a great difference in their sizes; the first bird, the hen, being very much larger. The smaller bird came only when its mate was at the eyrie and then too without any food except once when he landed with a serpent, only to take it away again. He never ate while at the nest even if the hen was doing so, nor did he stay for long. The regular frequency of the larger bird's visits might be explained by the cock passing his prey over to her off the nest and she bringing it across to the young, while she always bringing her catches direct to the nest, taking it away if the youngster was not hungry, or feeding herself on the nest. While doing so, she passed dainty morsels to the chick if it came nudging up. At this age the parent still fed the chick though very often it got up and ate by itself when alone.

In all identifiable cases the catch brought were sea snakes, and remains collected at the eyrie were also those of these reptiles with a single claw of a crab. The eaglet in my possession ate the entire

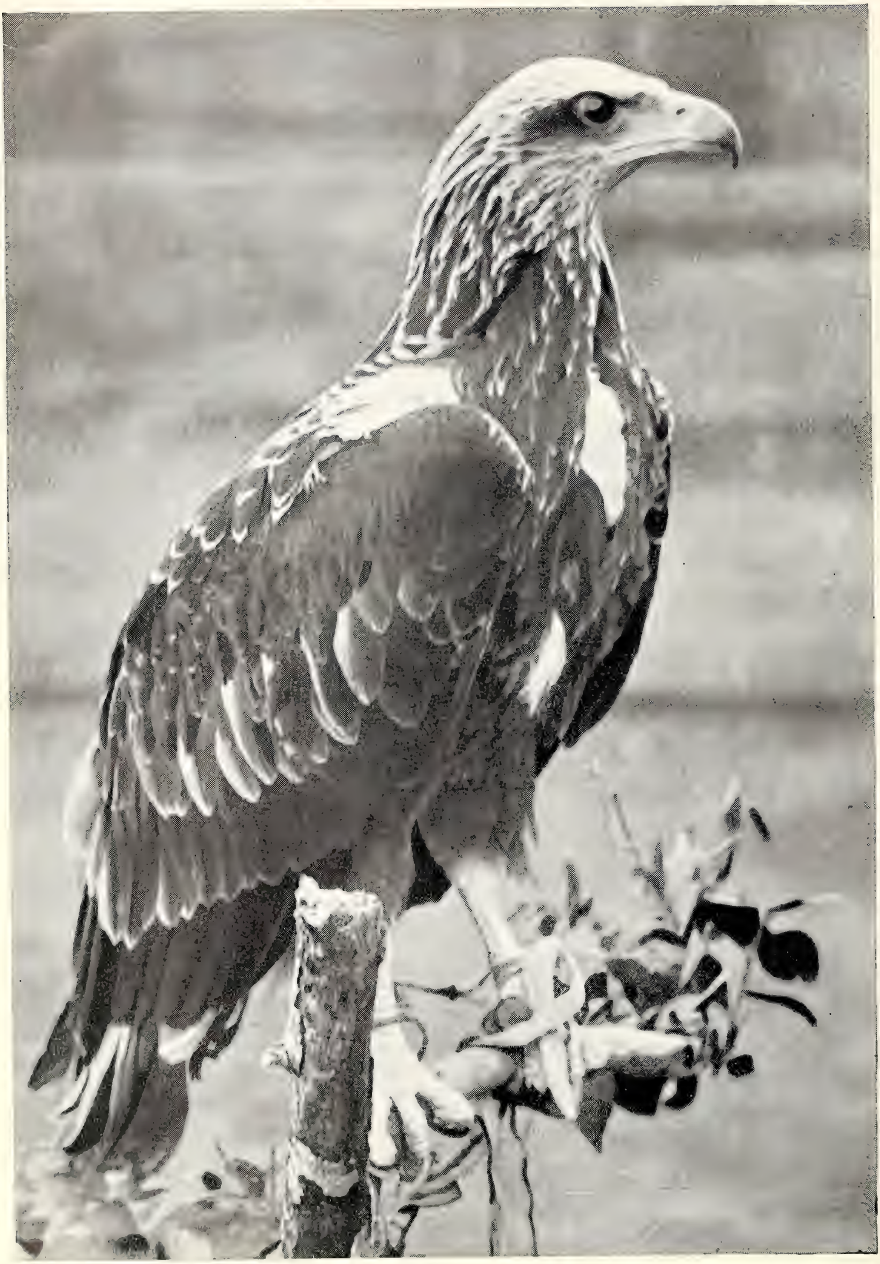


Hen feeding the eaglet.



The cock arrives calling.

(*Photos : K. S. Lavkumar*)



The eaglet, about two months old.

*(Courtesy : H.H. Maharaja of Baroda)*

fish whatever its size, only leaving the gill covers of the larger specimens. This could be the reason why no fish remains were found, and no doubt examination of castings would provide the clue. That sea snakes are the major item of diet at this time of the year is a fact and, though both Dharmakumarsinhji and Noronha have seen these birds with large fish, on no occasion while under observation did this pair of eagles bring any. Even Jerdon found serpents the major diet of these eagles at the Pigeon Island colony. Noronha's explanation is very plausible; according to him, fish come less to the surface in winter than at other times of the year when large numbers of fish are captured. Serpents, on the other hand, are easy prey as they surface for air.

The regularity of visits by the female was remarkable. On the third sitting, finding my watch had run out I set it to her arrival and found that I was out by only half an hour, a deflection of little consequence on an isolated island.

During the heat of the day, though the hen sat for long periods beside the eaglet, she never attempted to shade it; on the contrary she seemed to be at times in a hurry to get away to the trees at the other end of the island. At night the eaglet was left to itself, the parent arriving again at 8.30 a.m. next morning either with breakfast or merely for inspection. At night the eaglets lay down with their necks and heads stretched out in front. In the sun they often spread their wings for sunning to get relief from mites that were plentiful on their bodies. This attitude was also adopted as a show of agressiveness. When approached with food the captive sometimes called out, and once I heard the other eaglet similarly welcome its parent. The hen, on approach, was usually silent but on a couple of occasions she uttered a subdued *kench kench.*

While the weather was settled, a land breeze always blew during the morning, that is from the hide to the eyrie, and the birds approached from the opposite side flying very low to become visible only just before landing. A vagrant north wind that made approaching the island mildly dangerous gave me grand opportunities to get the adults in flight, for they now came in from the side flying high to drop down on the nest. The stiff breeze also seemed to have an exhilarating effect on the birds, for they flew around the eyrie landing and taking off repeatedly, calling all the time. Heat and stiffness were forgotten in the expectant thrill of watching these magnificent birds show off their paces.

When I look back on those days couped up in the confines of a 4′ × 4′ × 4′ hide, once from six-thirty in the morning to six-thirty in the evening, I wonder how I managed it. In all I spent four days of varying lengths at the observation post, with a two-day leave on the main island in between.

On January 22, prior to my leaving for the mainland and Bombay, I visited the wooded island to locate the other pair's eyrie. They were still building it, coming for branches to the trees below the lascar lines, diving down to wrench them off with their talons. This nest we found up in a tall silk cotton tree, and close beside was an older structure blown over. The vegetation on this island was very thick with great creepers, making walking difficult through the entwining

## WHITEBELLIED SEA

### Observations on number

| 16th January Observation from main island | 17th January Observation from Hide | 18th January Observation from Hide |
|---|---|---|
| 9·30 Both parents at nest. Feeding chick. | 8·30 ♀ brought food. Left nest immediately. | 7·45 Parents flew around. |
| 11·00 Parent flew to nest. Chased an intruder. | 9·00 ♀ brought food. ♂ joined her for short time, left. ♀ Fed herself. She flew away. Piece of snake in talons. | 8·35 Both arrived. ♀ with sea snake. ♂ flew off carrying piece of snake. |
| 11·30 Both parents visited nest, one with sea snake. One without food left immediately. | 11·45 ♀ arrived and fed eaglet.<br>12·20 ♀ left eyrie. | 8·40 ♀ left eyrie.<br>8·45 ♀ returned with food unidentified. Fed itself. Eaglet not interested.<br>9·00 ♀ fed chick while feeding self. |
| 11·40 Other bird left eyrie. Both settled in shade.<br>13·45 A parent at nest. | 18·30 ♀ arrived. Fed eaglet.<br>18 50 ♀ left eyrie. Eaglet feeding itself. | 9·05 ♀ left nest.<br>14·15 ♀ arrived with food unidentified. Watched young feed itself. |
| 14·15—14·45 A parent at nest.<br>15·00 Observation stopped. | | 14·20 ♀ circled around and settled again.<br>14·30 ♀ flew out to sea. Returned.<br>14·35 Relief party disturbed bird. |

## EAGLE *HALIAËTUS LEUCOGASTER*

### AND TIME OF VISITS TO NEST

| 19th January Observation from main island | 20th January Observation from Hide | 21st January Observation from Hide |
|---|---|---|
| 8·30 Both parents at nest. | 9·30 Entered hide. Disturbed ♀ feeding eaglet. | 8·45 Both parents arrived. Both with sea snakes. |
| | 10·45 ♀ returned but left immediately carrying away snake. | 8·50 Both left. ♂ carrying away snake. |
| | 11·10 ♀ arrived. Sat beside eaglet. | 9·00 ♀ returned. Fed self and chick. |
| | 11·15 ♀ left. | 9·03 ♀ left. |
| | 11·30 Eaglet feeding itself. | 9·10 ♀ returned with sea snake to carry it away again. |
| 12·20 one bird at nest. | 12[illegible] arrived with food ? Fed chick. | 12·50 ♀ arrived with food ? |
| 14·45 A parent at nest. Other bird circling around. Former left immediately. | 13·45 ♀ left nest. | 13·05 ♂ attempted to land. Flew off. |
| | 13·50 Both birds arrived. ♂ excited flew around, landing for short while. Both calling. ♂ flew off.<br>14·10 ♀ left.<br>14·13 ♀ arrived with food ? Fed eaglet.<br>14·45 ♂ arrived.<br>14·47 ♂ left.<br>14·50 ♂ returned.<br>14·55 ♀ fed. Flew off with remains of snake.<br>14·58 ♂ left.<br>Observation stopped. | 14·30 ♀ disturbed by relief party. |

## WHITEBELLIED SEA EAGLE *HALIAËTUS LEUCOGASTER*

### OBSERVATIONS ON NUMBER AND TIME OF VISITS TO NEST

| 16th January Observation from main island | 17th January Observation from Hide | 18th January Observation from Hide | 19th January Observation from main island | 20th January Observation from Hide | 21st January Observation from Hide |
|---|---|---|---|---|---|
| 9·30 Both parents at nest. Feeding chick.<br>11·00 Parent flew to nest. Chased an intruder.<br>11·30 Both parents visited nest, one with sea snake. One without food left immediately.<br>11·40 Other bird left eyrie. Both settled in shade.<br>13·45 A parent at nest.<br>14·15—14·45 A parent at nest.<br>15·00 Observation stopped. | 8·30 ♀ brought food. Left nest immediately.<br>9·00 ♀ brought food. ♂ joined her for short time, left. ♀ Fed herself. She flew away. Piece of snake in talons.<br>11·45 ♀ arrived and fed eaglet.<br>12·20 ♀ left eyrie.<br>18·30 ♀ arrived. Fed eaglet.<br>18 50 ♀ left eyrie. Eaglet feeding itself. | 7·45 Parents flew around.<br>8·35 Both arrived. ♀ with sea snake. ♂ flew off carrying piece of snake.<br>8·40 ♀ left eyrie.<br>8·45 ♀ returned with food unidentified. Fed itself. Eaglet not interested.<br>9·00 ♀ fed chick while feeding self.<br>9·05 ♀ left nest.<br>14·15 ♀ arrived with food unidentified. Watched young feed itself.<br>14·20 ♀ circled around and settled again.<br>14·30 ♀ flew out to sea, Returned.<br>14·35 Relief party disturbed bird. | 8·30 Both parents at nest.<br>12·20 one bird at nest.<br>14·45 A parent at nest. Other bird circling around. Former left immediately. | 9·30 Entered hide. Disturbed ♀ feeding eaglet.<br>10·45 ♀ returned but left immediately carrying away snake.<br>11·10 ♀ arrived. Sat beside eaglet.<br>11·15 ♀ left.<br>11·30 Eaglet feeding itself.<br>12[illegible] arrived with food? Fed chick.<br>13·45 ♀ left nest.<br>13·50 Both birds arrived. ♂ excited flew around, landing for short while. Both calling. ♂ flew off.<br>14·10 ♀ left.<br>14·13 ♀ arrived with food? Fed eaglet.<br>14·45 ♂ arrived.<br>14·47 ♂ left.<br>14·50 ♂ returned.<br>14·55 ♀ fed. Flew off with remains of snake.<br>14·58 ♂ left.<br>Observation stopped. | 8·45 Both parents arrived. Both with sea snakes.<br>8·50 Both left. ♂ carrying away snake.<br>9·00 ♀ returned. Fed self and chick.<br>9·03 ♀ left.<br>9·10 ♀ returned with sea snake to carry it away again.<br>12·50 ♀ arrived with food?<br>13·05 ♂ attempted to land. Flew off.<br>14·30 ♀ disturbed by relief party. |

growth. On the main island only the larger trees were left with scarcely any undergrowth. This was the work of goats allowed to run around the house to provide the lighthouse family with fresh milk but, when their depredations were directed toward the new mango saplings, they had to be banished. The damage had already been caused. However, in a few years the vegetation should regenerate itself if the ban on goats is not lifted.

*Haliaëtus leucogaster* is not uncommon along this coast, and in the Karwar Bay alone I was able to make out six pairs, all presumably breeding. Its loud clanging call is a familiar sound in Karwar though few people recognise the originator as it flies at great heights. On the islands the birds come very low and are well known to the fishermen. It is believed that when the Kankan calls, there is sure to be a SW. wind.

The co-operation and enthusiasm of all those I had to deal with in Karwar has suggested another visit to the Oyster Rocks to gather scientific data on this eagle. Thanks are due to R. S. Dharmakumarsinhji of Bhavnagar who sponsored the venture right from its conception, Mr. Gokarna of the Forest Department for looking after my interests on the mainland, and finally to Mr. Noronha of the Oyster Rocks Light without whose help and hospitality everything would have been so much more difficult.

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# BOTANICAL EXPLORATIONS IN THE BHILLANGNA VALLEY OF THE ERSTWHILE TEHRI GARHWAL STATE

BY

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(*With a map*)

## INTRODUCTION

To the scientific world, the flora of Tehri Garhwal is known only by collections of Davidson, Duthie, Gamble, King, Keshwanand and others, who collected plants from the valleys of upper Tons, Pabar, Rupin, and Ganga. Their collections are preserved in the herbarium of the Forest Research Institute, Dehra Dun. Little has been published on the botany of the area, though much work has been done on the botany of the neighbouring hills in Pauri Garhwal. Osmaston has described the forest types of the Garhwal district lying across the Himalaya; Troupe has given some notes on the vegetation of the same. Some information has been recorded by Hooker in his introductory essay in 'Flora Indica' and also in the chapter on the vegetation of India in the Imperial Gazetteer of India, though all of his personal experiences had been in Sikkim. Smythies, Champion, Raturi, Keshwanand and other forest officers contributed some important notes in connection with the distribution of vegetation. Later on Dudgeon and Kenoyer described the ecology of Tehri Garhwal based on their field notes on their trip to Gangotri in 1921. However, in spite of the many papers on the region no systematic description of plants has been given; further some areas of this district are still untouched in the botanical sense. The present author has attempted to explore some parts of the Bhillangna valley, and his notes may be of interest to botanists and plant geographers alike.

This paper is based mainly on the observations made during trips to Masar Tal lake (10,000 ft.) and the collections from Sahsru Tal lake (16,000 ft.). The collections and observations were made in the months of May and September respectively, and have been supplemented by observations at Naini Tal and Mussoorie.

Sri P. N. Gupta, Divisional Forest Officer of Tehri Division, accompanied and greatly helped me in my collection tours. My specimens have been identified at the herbarium of the Forest Research Institute, Dehra Dun, and are preserved in the herbarium of the Government College at Tehri.

## PHYSICAL FEATURES AND GEOGRAPHY

Tehri Garhwal is situated between lat. 30° 3′ and 31° 18′ N. and long. 77° 53′ and 79° 28′ E., and has an area of about 4,500 sq. miles. It is surrounded by Rawain and Bashahar in the north, Tibet in the east, Pauri Garhwal in the south and Dehra Dun in the west. It lies entirely within the Himalayan ranges and consists of a series of ridges separated by narrow valleys. The ridges run mainly from northeast to southwest, radiating from lofty peaks on the border of Tibet.

The area is drained by two main rivers, the Ganga and the Yumna, which come out of the district near Munikireti (Rishikesh) and Kalsi (Dehra Dun) respectively. The river Ganga rises from Gaumukh (13,750 ft.) and is known under the name of Bhagirathi; within the area the Ganga is fed by the rivers Bhillangna and Alaknanda, which meet the main stream at Tehri (2,278 ft.) and Deopryag (1,474 ft.) respectively. This forms the southern boundary of the district. The river Yumna rises from Bunderpunch (20,720 ft.) and flows southwest and forms the western boundary of the district.

Burrard and Hayden divide the Himalayas into three zones; the Greater Himalayas, the Lesser Himalayas and the Siwaliks. The area of our explorations, according to them, lies entirely within the former two zones. The Lesser Himalayas are roughly uniform in height, between 6,000 ft. and 10,000 ft. The greater Himalayas contain snowy peaks, the average height of which exceeds 20,000 ft.; but there are some deep river valleys.

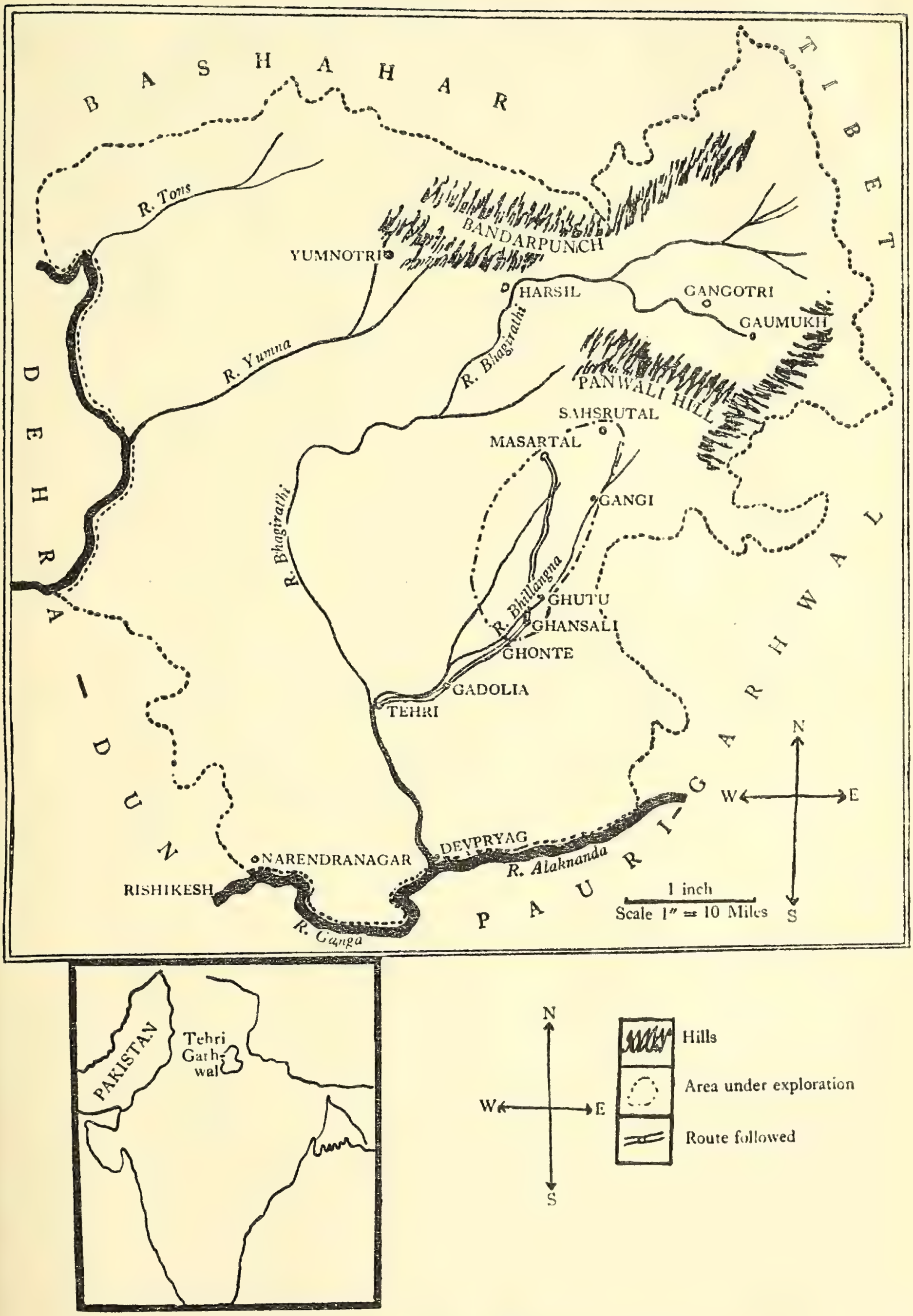
## GEOLOGY

The geological survey of the erstwhile Tehri Garhwal state has contributed some information on the geology of the area, but the information is rather scanty. The Lesser Himalayan peaks are composed of a series of sedimentary rocks such as slates, quartzites, conglomerates and limestones; the higher Himalayan region is made of granite and crystalline rocks. The composition of the rocks from the area varies greatly in colour, form and composition. However, fossils have not been recorded so far from this area.

## CLIMATE

The physical features of the district as a whole being so varied, there is naturally great range in climate; the lower and outer ranges have a climate similar to that of the plains; whilst the higher peaks are covered with perpetual snows. As there are no meteorological data available from the area itself, one must have recourse to the stations near the edge of the mountains in Dehra Dun district. Dehra Dun, at a height of about 2,223 ft. above sea level, has a mean annual temperature of 71° F.; Mussoorie at 6,705 ft. has a mean temperature of 57·4° F. Blanford gives a depression of about 1° F. for each 300 ft. rise in elevation in the Western Himalayas; thus at 11,000-12,000 ft., the mean temperature would be about 42° F.-45° F.

There is an increase in the dryness of the atmosphere from east to west. The annual rainfall ranges from 32″ at Tehri to 125″ at Narendranagar; at some places, however, there is a short spell of misty weather, actual rainfall being rare. Schimper says (p. 694) that 'increasing altitude is associated with increase in rainfall . . .


BASHAHAR
TIBET
DEHRA-DUN
PAURI-GARHWAL
R. Tons
R. Yumna
R. Bhagirathi
R. Bhillangna
R. Alaknanda
R. Ganga
BANDARPUNCH
YUMNOTRI
HARSIL
GANGOTRI
GAUMUKH
PANWALI HILL
SAHSRUTAL
MASARTAL
GANGI
GHUTU
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1 inch
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PAKISTAN
Tehri Garhwal
Hills
Area under exploration
Route followed

Tehri Garhwal showing Bhillangna Valley

up to a certain level'; above this level atmospheric precipitation again diminishes. He quotes Hill (p. 695) that the line of greatest rainfall in the Himalayas lies at 1,270 m. (4,165 ft.) above sea level. Here the rainfall amounts to 3.7 times as much as in the neighbouring plains, but at 3,000 m. (9,040 ft.) it is only 1/5 of the former. As data on the rainfall of the district are not available, we can but guess the rainfall from the records available from the adjacent hills in the district of Dehra Dun. In Dehra Dun proper the annual rainfall is 85″, in Rajpur (3,200 ft.) it is 119″, and at Mussoorie 94″. So we may deduce that at a height of 9,840 ft. it must be 40″. The northern slopes of the valleys receive much less precipitation; and summer rains are scanty north of the snowy peaks.

Relative humidity is greatest at about 7,000 ft.; above this height there are great fluctuations. The absolute humidity decreases with falling temperature in passing to higher altitudes. As we pass northwards the precipitation is in the form of snow. In general the spring is sunny and moist due to winter rains and melting snows; the summer is dry. The rainy season is warm with rains and high humidity. Autumn is sunny and dry; while the winter is cold with rains and low humidity. The climate is so different at varying altitudes that no general statement can be made on the climate of the whole area.

## CLIMATIC ZONES

The entire area in the Bhillangna Valley can be divided into three climatic zones very similar to Hooker's three climatic zones of Western Himalayas:

1. Tropical, extending up to 5,000 ft., i.e., a little above Ghansali.
2. Temperate, from 5,000 ft. to 12,000 ft., i.e., the upper limit of trees, a little above Masar Tal.
3. Alpine, from 12,000 ft. to 18,000 ft., i.e., the upper limit of flowering plants.

### Tropical Zone:

This zone extends up to 5,000 ft., the lower limit of snowfall during winter. Annual rainfall 80-90″. The temperature rarely falls below freezing point during winter; in May it rises to 105° F. or above. The monsoon starts about the middle of June, and it continues to about the end of September. The rainy season is characterized by general cloudiness and heavy rainfall; clouds frequently roll on the ground and humidity reaches saturation point for a considerable period. During autumn there is continuous sunshine without rain, and consequently humidity is much reduced. Spring is sunny without rains and is the hottest season of the year.

### Temperate Zone:

Here the temperatures are lower, precipitation is less and a considerable portion of it is in the form of snow. During June to September the forests are enveloped in thick monsoon clouds and the air is saturated with water vapour. About 70-80% of the annual precipitation falls as rain. Autumn is sunny, with low humidity, and the temperature falls during winter below 32° F. Spring days are cloudless with rising temperature. The ground remains moist from the melting of the snows and the humidity is never very low. With the advance of the dry season, humidity reaches a low point, whilst temperatures reach their highest.

### Alpine Zone:

This zone extends from above the tree line. In this region winters are cold and the growing season for plants is very short. The spring and autumn seasons are practically eliminated. Precipitation is very small and that, too, in the form of snow. The monsoon begins a little earlier than over the outer mountains, but the total rainfall is much lower. During summer day temperatures are tolerable, the nights are decidedly cold. Between the end of summer rains and the beginning of winter, the season is very pleasant; it is the best season for plant collection. Winters are characterized by heavy snowfalls; this snow only disappears with the starting of the monsoon.

## THE VEGETATION OF THE AREA

The flora of the district varies between sub-tropical species in the outer ranges of the hills and rich alpine forests in the northern hills. The flora of the valley can be divided for the sake of convenience into three zones on the basis of the climatic zones:

1. Tropical and Sub-tropical Zones, covering the lower slopes.
2. Temperate Zone, covering middle elevations.
3. Alpine Zone, covering the greater heights bounded on the north by snow line.

### Tropical and Sub-tropical Zone.

These forests cover the large tracts of the slopes of lower hills in the valley, between 2,000 ft. and 5,000 ft. above sea level. The following trees are given roughly in order of their abundance:

*Bauhinia variegata* Linn.
*Bauhinia retusa* Roxb.
*Bauhinia vahlii* W. et A.
*Grewia oppositifolia* Buch.-Ham.
*Grewia tiliaefolia* Vahl
*Mallotus philippensis* Muell.-Arg.
*Terminalia chebula* Retz.
*Terminalia belerica* Roxb.
*Eugenia jambolana* Lamk.

The forests are dense and moderately shady. During February-April, they are leafless, and the ground is covered with thick coating of dried leaves. Undershrubs are scanty.

Along the river in the valley the following plants are common:

*Nyctanthes arbor-tristis* Linn.
*Woodfordia fructicosa* (Linn.) Kurz
*Glochidion velutinum* Wight
*Bridelia montana* Royle

*Rhus parviflora* Roxb.
*Zanthoxylum alatum* Roxb.
*Murraya koenigii* Spr.
*Cocculus laurifolius* DC.
*Phoenix* sp.
Several Leguminosae.

Along the edges of terraced fields and over abandoned fields the following plants were seen:

*Berberis lycium* Royle
*Rosa moschata* Mill.
*Rubus ellipticus* Sm.
*Carissa spinarum* Linn.
*Prinsepia utilis* Royle
*Adhatoda vasica* Nees

At Tehri proper it is almost dry with very little vegetation. The vegetation is purely xerophytic. The following trees are generally cultivated:

*Mangifera indica* Linn.
*Ficus religiosa* Linn.
*Ficus bengalensis* Linn.
*Aegle marmelos* Correa
*Emblica officinalis* Gaertn.
*Citrus* sp.

On the dry rocky cliffs, shrubs of *Euphorbia royleana* Boiss., *Carissa spinarum* Linn., *Zanthoxylum alatum* Roxb., *Zizyphus oxyphylla* Edgew., *Agave americana* Linn. and *Lantana camara* Linn. are common.

The principal component of the vegetation of the valleys in the lower hills is *Pinus roxburghii* Sarg. (*Pinus longifolia*) and is usually found alone restricted to exposed dry places. It appears to possess the power of driving away all the vegetation from the tract which it occupies. The floor of the forests is usually grassy with thick dry needles in summer. Undershrubs are xerophytic and few. Some of them are:

*Rubus ellipticus* Sm.
*Berberis lycium* Royle
*Indigofera gerardiana* Wall.
*Aechmanthera tomentosa* Nees
*Inula* sp.
*Eupatorium* sp.

Temperate Zone:

In this zone towards the upper limit in cold aspect *Pinus roxburghii* Sarg. is mixed with *Quercus incana* Roxb. Higher up it is associated with:

*Rhododendron arboreum* Smith
*Pieris ovalifolia* D. Don
*Pyrus pashia* Buch.-Ham.
*Viburnum cotinifolium* Don

The principal shrubs are:

*Berberis aristata* DC.
*Desmodium tiliaefolium* G. Don
*Rhamnus procumbens* Edgew.
*Deutzia corymbosa* Br.
*Daphne cannabina* Wall.
*Myrsine africana* Linn.
*Rosa moschata* Mill.
*Jasminum humile* Linn.

Herbaceous vegetation is luxuriant during and after the monsoon. The commoner plants are:

*Thalictrum javanicum* Bl.
*Hedychium* sp.
*Oenothera rosea* Sol.,

with some ground orchids, ferns; Compositae and Umbelliferae are also found.

Above 8,000 ft. *Quercus incana* gives place to *Quercus floribunda* Wall. (syn. *Quercus dilatata* Lindl.) and *Quercus semicarpifolia* Smith, and up to 10,000 ft. the following trees are commonly seen:

*Skimmia laureola* Hook. f.
*Aesculus indica* Colebr.
*Cotoneaster bacillaris* Wall.
*Taxus baccata* Linn.
*Pieris ovalifolia* D. Don
*Arundinaria spathiflora* Trin.
*Viburnum nervosum* Don
*Viburnum stellulatum* Wall.
*Euonymus lacerus* Ham.

The undergrowth is composed of

*Hedera nepalensis* Koch.
*Rhamnus virgatus* Roxb.
*Taraxacum officinale* Wigg.
*Polygonatum verticillatum* Allioni
*Cypripedium cordigerum* Don

In the lake at Masar Tal and Sahsru Tal no plants were seen. As the higher elevations are approached, trees of silver fir and spruce become more and more abundant, and above all birch *Betula utilis* are present up to 12,000 ft. After this the vegetation becomes typical of the alpine type.

On the sides of the lake at Masar Tal in rich green grass the following plants were collected:

*Gentiana argentea* Royle
*Anemone obtusiloba* D. Don
*Ranunculus hirtellus* Royle
*Taraxacum officinale* Wigg
*Anemone* sp.
*Poa* sp.

### Alpine Zone

This zone covers altitudes between 12,000 ft. and 18,000 ft. above sea level, and forms the upper limit reached by flowering plants. Above 12,000 ft. alpine formations in the form of meadows with a few shrubs become common. The following plants are common:

*Aconitum heterophyllum* Wall.
*Primula* sp.
*Saxifraga* sp.
*Corydalis* sp.
*Poa* sp.

In addition to the special formations mentioned for the various zones some other coniferous edaphic climax forests were also seen. They constitute the pine forests at 3,000 ft.- 6,500 ft. and *Cedrus deodara* Loud. forests at 5,500 ft.-10,500 ft. They are not characteristic forest trees, and large natural forests of deodar are present below the general climatic climax of the region. The *Pinus longifolia* and *Cedrus deodara* forests appear to be climatic climax and the scarcity of soil water due to physical conditions can be regarded as the determining factor.

## ACKNOWLEDGEMENTS

The author is deeply indebted to Sri. M. B. Raizada, Officer-in-Charge, Botany Branch, Forest Research Institute, Dehra Dun, for allowing him to work in the Institute and helping him in the identification of some specimens, to Rev. Fr. H. Santapau, Director, Biological Section, St. Xavier's College, Bombay, for critically examining and suggesting improvements in the manuscript, and to Prof. K. S. Bhargava, Head of the Botany Department, Govt. Degree College, Naini Tal, for constant encouragement during the course of the work.

## LIST OF THE SPECIMENS COLLECTED

The plants in the appended list have been collected from the area shown in the map during this author's visit to Masar Tal lake. Plants from Sahsru Tal lake have not been given. The reference numbers given after the specimens refer to herbarium sheets possessed by the author. The author has tried his best to adjust the nomenclature of the plants to the latest findings on the subject; plants marked with an asterisk have not been described by Collett in *Flora Simlensis*.

### RANUNCULACEAE

**Ranunculus laetus** Wall.

Small herb, with bright yellow flowers, at 3,000 ft. near Bhillangna river at Ghansali (*Gupta* 16, 59).

**R. hirtellus** Royle

Herb. with bright yellow flowers, at 9,500 ft. near lake at Masar Tal (*Gupta* 58).

**Anemone obtusiloba** D. Don

Herb, with flowers which are white when open, but the underside is blue. In open grass slopes at 10,000 ft. near the lake at Masar Tal (*Gupta* 65).

**Anemone** sp.

Small herb, with white flowers about 5″ in height, at 10,000 ft. near the sides of the lake (*Gupta* 26).

**Delphinium denudatum** Wall.

Herb, with blue spurred flowers at 6,000 ft. (*Gupta* 32).

### BERBERIDACEAE

**Berberis aristata** DC.

Prickly shrub, with yellow flowers at 6,000 ft. (*Gupta* 34, 46).

### VIOLACEAE

**Viola canescens** Wall.

Small herb, with blue flowers, in shady places in the fir forest at 8,500 ft. (*Gupta* 51).

### CARYOPHYLLACEAE

**Stellaria latifolia** Benth.

Small herb, with white flowers, at 3,500 ft. at Ghansali (*Gupta* ?)

**Stellaria media** Linn.

Small diffused herb, at 7,000 ft. (*Gupta* 67).

**Arenaria serpyllifolia** Linn.

Diffused herb, with small leaf and white flowers, at Ghansali near river Bhillangna (*Gupta* 9).

### GERANIACEAE

**Oxalis corniculata** Linn.

Small herb, common in shady places, with yellow flowers (*Gupta* 19).

### AQUIFOLIACEAE

**Ilex dipyrena** Wall.

Small evergreen tree, in fir forest. A small sapling has been collected (*Gupta* 61).

### SAPINDACEAE

**Aesculus indica** Colebr.

Large tree, in fir forests at 10,000 ft. (*Gupta* ?)

**Acer caudatum** Wall.

Large tree, in fir forest at 9,500 ft. (*Gupta* 71).

## LEGUMINOSAE

**Lespedeza stenocarpa** Maxim.

Shrub, 3–5 ft. high, silky, with red flowers, in pine forests at 4,000 ft. (*Gupta* 21).

**Indigofera gerardiana** Wall.

Shrub, with few leaflets, flowers purple, in oak forests at 6,000 ft. (*Gupta* 48).

**Crotalaria albida** Heyne

Herb, 1-2 ft. high, with yellow flowers at 4,000 ft. (*Gupta* 18).

## ROSACEAE

**Prunus padus** Linn.

Tree, with white drooping racemes, in *moru* forests at 8,000 ft. (*Gupta* 84).

**Fragaria vesca** Linn.

Herb, with small white flowers, on way to Masar Tal (*Gupta* 72).

**Potentilla fulgens** Wall.

Small silky herb, common at Chirbatya at 8,000 ft. Flowers not seen (*Gupta* 31, 81).

**Potentilla** sp.

Small herb, about 5″ in height, with yellow flowers, at 8,000 ft. (*Gupta* 10, 15).

**Rosa sericea** Lindl.

Erect shrub, 4-8 ft. high with white flowers, at 9,000 ft. in *kharsu* forest (Gupta 80).

**R. macrophylla** Linn.

Shrub, 6-10 ft., flowers not seen (*Gupta* 82).

**R. moschata** Mill.

Climbing shrub, with white flowers, commonly seen at 4,000 ft. (*Gupta* 43).

**Pyrus pashia** Buch.-Ham.

Small trees, with white pinkish flowers at 7,500 ft. (*Gupta* 57).

**Pyranthus crenulatus** Rehd.

Large shrub, with white flowers, spiny, in oak forest at 6,000 ft. (*Gupta* 56).

**Cotoneaster bacillaris** Wall.

Large shrub, 10-18 ft. high, with white flowers, at 8,000 ft. (*Gupta* 42).

**C. microphylla** Wall.

Densely branched prostrate shrub, with white flowers, commonly seen at 6,000 ft. (*Gupta* 36).

### LYTHRACEAE

**Woodfordia fruticosa** (Linn.) Kurz

Shrub, with red flowers, very common in the valley at Ghansali at 3,500 ft. (*Gupta* 20).

### ONAGRACEAE

****Oenothera rosea** Sol.

Herb, about 11″ high, with pink flowers, very commonly seen at Geonli at 6,000 ft. (*Gupta* 15).

### FICOIDEAE

**Mollugo pentaphylla** Linn.

Herb, much branched, with pink flowers at Ghansali (*Gupta* 17).

### UMBELLIFERAE

**Pimpinella** sp.

Erect herb, in fir forest, flowers not seen (*Gupta* 70).

### ARALIACEAE

**Hedera nepalensis** Koch.

Climber, adhering to fir trees by rootlets, common in fir forest at 8,500 ft. (*Gupta* 83).

### CAPRIFOLIACEAE

**Viburnum cotinifolium** Don

Shrub, with white flowers, at 7,500 ft. (*Gupta* 41, 60).

**V. stellulatum** Wall.

Large shrub, with small flowers, at 9,000 ft. in *kharsu* forest (*Gupta* 87).

**Lonicera quinquelocularis** Hardw.

Large shrub, with yellow flowers, at 8,000 ft. (*Gupta* 66).

### RUBIACEAE

** **Oldenlandia gracilis** Hook. f.

Herb, on grassy slopes, with white flowers, at Paonli rest house (*Gupta* 28).

### COMPOSITAE

**Gnaphalium luteo-album** Linn.

Small herb, woolly, common at Ghansali (*Gupta* 11).

**Caesulia axillaris** Roxb.

Small herb, common at Ghansali (*Gupta* 11).

**Artemisia nilagirica** Pam.

Small herb, with underside of leaf white, common at Ghansali (*Gupta* 13).

**Gerbera lanuginosa** Benth.

Herb, with silky leaves, on grassy slopes (*Gupta* 47).

**Myriactis wallichii** Less.

Small herb, with yellow flowers, commonly seen on roadside (*Gupta* 5).

**Sphaeranthus indicus** Linn.

Herb, with flowers in globose heads, common in rice fields at Ghansali (*Gupta* 26).

**Crepis japonica** Benth.

Herb, with flowers which are yellow, at 5,000 ft. (*Gupta* 3).

**Taraxacum officinale** Wigg.

Herb, with yellow flowers, commonly seen at 4,000 ft. and at 10,000 ft. near the sides of the lake at Masar Tal (*Gupta* 35, 78).

**Prenanthes** sp.

Herb, in fir forest at 10,000 ft., flowers, not seen (*Gupta* 74).

**Sonchus oleraceous** Linn.

Succulent herb with yellow flowers, at Ghansali (*Gupta* 27).

**Tragopogon gracile** Don

Herb, with yellow flowers on grassy slopes at 7,000 ft. (*Gupta* 39).

****Tridax procumbens** Linn.

Weak herb, common on roadsides at Ghansali (*Gupta* 22).

**Ainslea pteropoda** DC.

Herb, with flowers in spike, common at 6,000 ft. (*Gupta* 44).

### ERICACEAE

**Rhododendron arboreum** Smith

Tree, with conspicuous red flowers, at 7,000 ft. (*Gupta* 55).

### PRIMULACEAE

**Primula petiolaris** Wall.

Herb, with purple flowers, common in damp shady places above 8,500 ft. (*Gupta* 85).

**Androsace rotundifolia** Hardw.

Herb, with pink flowers at 7,000 ft. (*Gupta* 40).

### GENTIANACEAE

**Gentiana argentea** Royle

Small herb, in grass with blue flowers, on the edge of Masar Tal lake at 10,000 ft. (*Gupta* 63).

### BORAGINACEAE

**Trichodesma indicum** R. Br.

Hairy herb, with pale blue flowers, in the valley at 5,000 ft. (*Gupta* 38).

### SCROPHULARIACEAE

**Verbascum thapsus** Linn.

Herb, woolly, with yellow flowers in long terminal spikes (*Gupta* 37).

**Veronica anagallis** Linn.

Herb, with white flowers, at Ghansali (*Gupta* 12).

### LABIATAE

**Coleus** sp.

Herb, at 4,000 ft. at Ghansali (*Gupta* 29).

**Micromeria biflora** Roxb.

Small herb, with pink flowers, common up to 7,000 ft. (*Gupta*).

**Salvia lanata** Roxb.

Woolly herb, with blue flowers, at 5,000 ft. (*Gupta* 33).

**Ajuga bracteosa** Wall.

Hairy herb, with lilac flowers, at Ghansali (*Gupta* 8).

### NYCTAGINACEAE

**Boerhavia repens** Linn.

Herb, with minute pink flowers, at Ghansali (*Gupta* 1).

### POLYGONACEAE

**Polygonum plebejum** R. Br.

Small herb, with minute flowers, at Ghansali (*Gupta* 6).

**P. alatum** Buch.-Ham.

Herb, with white flowers, at Ghansali (*Gupta* 25).

**P. orientale** Linn.

Hairy herb, with red flowers, in racemes at 4,500 ft. (*Gupta* 25).

****P. viviparum** Linn.

Herb, with coriaceous leaves, flowers not seen by me, common in fir forest (*Gupta* 68).

**P. capitatum** Buch.-Ham.

Herb, with pink flowers, at 9,000 ft. in damp places (*Gupta* 76).

## LAURACEAE

**Cinnamomum tamala** Nees

Large shrub, with aromatic three-nerved leaves, at 4,500 ft. (*Gupta*).

**Machilus odoratissima** Nees.

Large tree, with lanceolate leaves (*Gupta* 49).

## EUPHORBIACEAE

**Euphorbia pilosa** Linn.

Juicy herb, with yellow green bract, at 6,000 ft. (*Gupta* 45).

**E. royleana** Boiss.

Cactus-like fleshy shrub, common on dry rocky cliffs (*Gupta*).

**Mallotus philippinensis** Muell.-Arg.

Small tree, with red powder in capsule (*Gupta*).

## SALICACEAE

**Salix elegans** Wall.

Small tree, common at Chirbatya, at 7,000 ft. (*Gupta* 30).

## CONIFERAE

**Taxus baccata** Linn.

Trees with peculiar aromatic smell, at 10,000 ft. on way to Masar Tal (*Gupta* 76).

## ORCHIDACEAE

**Goodyera repens** R. Br.

Ground orchid, with leaves having shining veins, in fir forests at Masar Tal (*Gupta* 64).

**Cypripedium cordigerum** Don

Herb, with solitary terminal flower, in fir forest (*Gupta* 73).

## LILIACEAE

**Asparagus filicinus** Buch.-Ham.

Erect herb, with tuberous roots, in fir forest (*Gupta* 79).

**Polygonatum verticillatum** Allioni

Herb, with flowers in whorled spikes, in fir forest at Masar Tal (*Gupta* 77).

(List of the plants from Sahsru Tal to be continued.)

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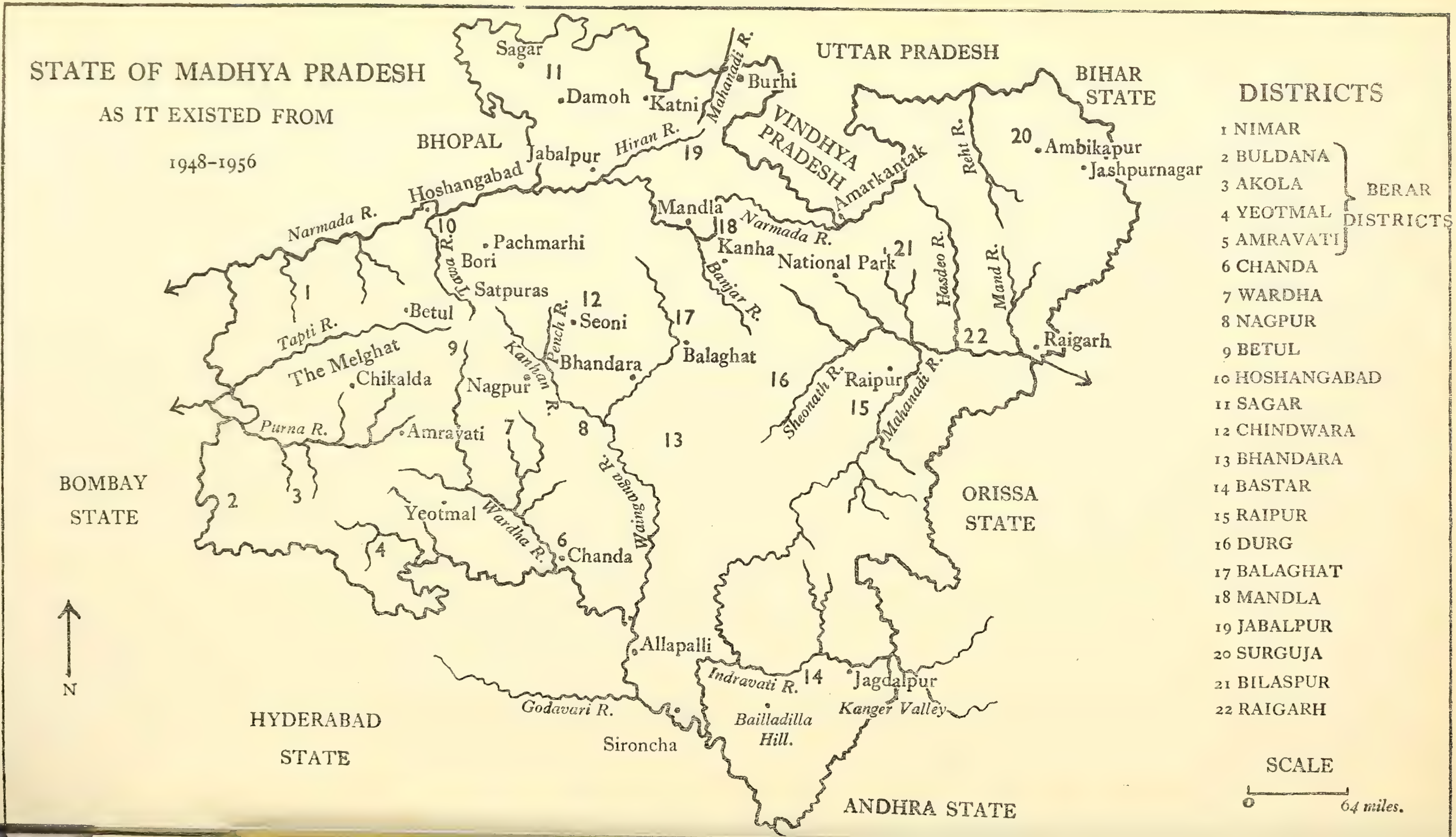
## STATE OF MADHYA PRADESH
AS IT EXISTED FROM
1948–1956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8 NAGPUR
9 BETUL
10 HOSHANGABAD
11 SAGAR
12 CHINDWARA
13 BHANDARA
14 BASTAR
15 RAIPUR
16 DURG
17 BALAGHAT
18 MANDLA
19 JABALPUR
20 SURGUJA
21 BILASPUR
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BOMBAY STATE
HYDERABAD STATE
ORISSA STATE
ANDHRA STATE
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Damoh
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Burhi
Mahanadi R.
Jabalpur
Hiran R.
Hoshangabad
Narmada R.
Amarkantak
Ambikapur
Jashpurnagar
Rehi R.
Mandla
Kanha
National Park
Hasdeo R.
Mand R.
Pachmarhi
Bori
Tawa R.
Satpuras
Betul
Tapti R.
Pench R.
Seoni
Bhandara
Balaghat
Banjar R.
Raigarh
The Melghat
Chikalda
Nagpur
Kanhan R.
Raipur
Sheonath R.
Purna R.
Amravati
Wainganga R.
Yeotmal
Wardha R.
Chanda
Allapalli
Indravati R.
Jagdalpur
Kanger Valley
Godavari R.
Sironcha
Bailladilla Hill.
]

# OBSERVATIONS ON THE BIRD LIFE OF MADHYA PRADESH

BY

C. E. HEWETSON, I.F.S. (Retd.)

(*With a map and four plates*)

## SCOPE

The justification for this article is that so far in India there have been few accounts written by a person who has lived for nearly 30 years (1926–1955) in one State of India, and has recorded the status of the local birds. Ornithological surveys collect all the birds they can find, but have only a short time to assess the relative abundance or status of each species. Books like the Fauna of British India describe the distribution of birds by the specimens received from different places, but have no idea whether these represent samples of an evenly distributed population or of locally distributed pockets, or of passage migrants. In addition, central India has been unfortunate in that few naturalists have worked in it, either zoologists or botanists, and records are correspondingly meagre. This article therefore attempts to assess the status and local distribution of the species which can be expected to occur in Madhya Pradesh. They are my own personal observations since 1928. I have also given references to other articles on bird life in central India.

The extent of the area covered is the State of Madhya Pradesh as it existed after January 1, 1948, i.e., with the addition of 14 states to the old unit known as the Central Provinces and Berar. During 28 years I have seen every part of the State, but I have spent only a few days in the northernmost district of Sagar. Without intensive specimen collecting a close observer can expect to see round about 350 species of birds in central India if he keeps on for 15–20 years.

## METHOD OF STUDY

The observations are all visual and I have not shot any birds for identification in the hand. As I have not attempted to determine the boundaries of geographical races, this does not matter for the birds which are easily recognized, but my observations on the groups of birds without strongly marked colour characteristics or which are difficult to observe for other reasons are admittedly deficient. These groups are the warblers and associates, the larks and pipits, the owls and the quails.

## VALUE

I hope these observations will be of value as indicating in broad outline the pattern of bird distribution in a large part of central India and will also provide some ecological data of the birds found in each main habitat. The birds listed and observed by me make up the main bird population, but occasional individual stragglers may be found from year to year. Particularly in winter, birds wander about over the Indian continent, and in peculiar weather conditions unusual birds may pass through.

## HABITATS

The following main habitats (biotopes) may be recognized though of course they grade into each other :

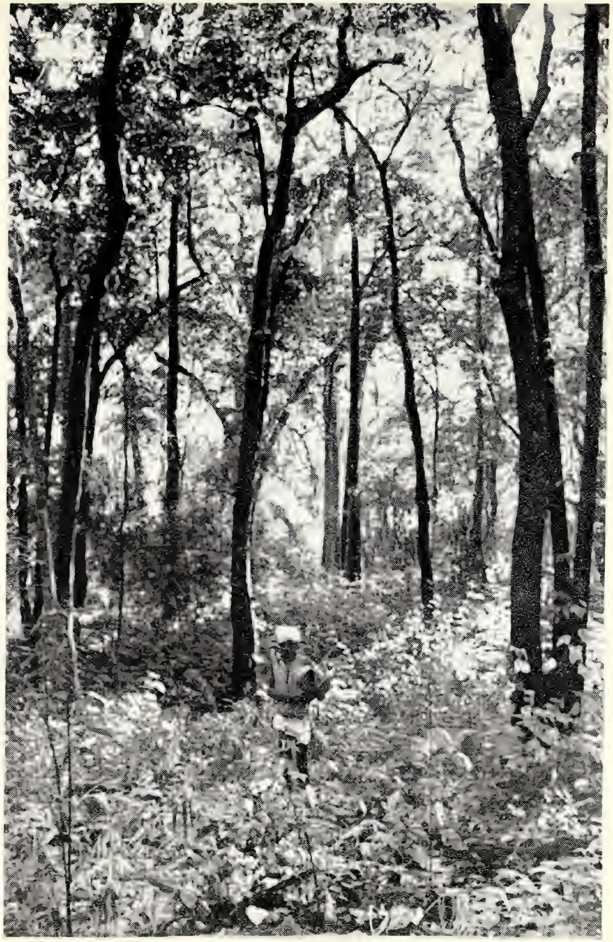
A. Closed Mixed Deciduous or Sal Forest. Plates I, II.
B. Open Cultivation and Waste Lands. Plate III.
C. Scrub Forest intermediate between A and B. Plate IV.
D. Reservoirs and Irrigation lakes or ponds (tanks).
E. River Beds. Plate IV.

### A. Closed Mixed Deciduous or Sal Forest

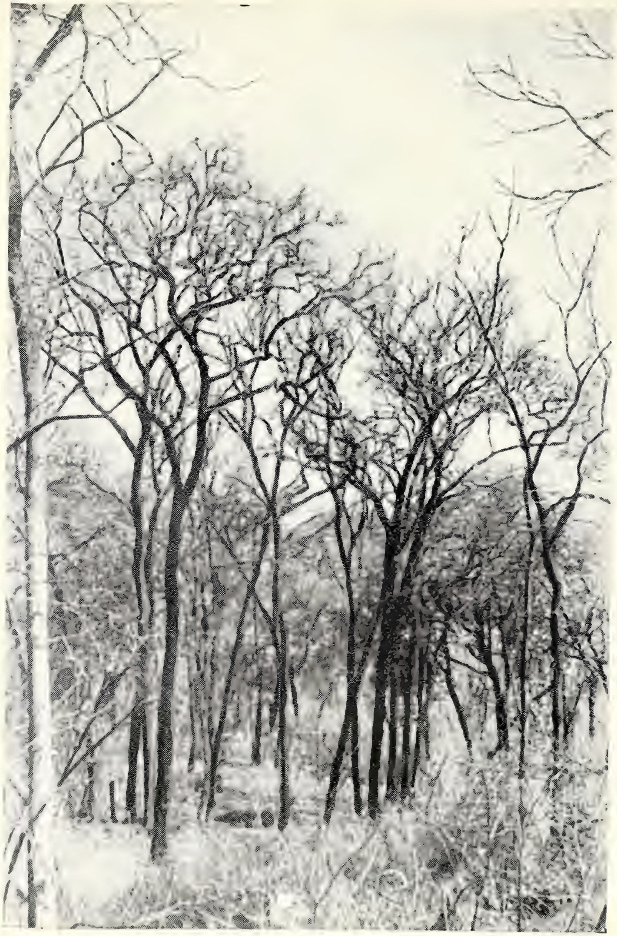
From the bird's point of view I class all the closed forest as one biotope. The Mixed Deciduous Forest does contain a number of variations important to the forest officer, the ecologist or the botanist, but within wide limits they provide similar living conditions for birds. No forests are so continuous or dense that small gaps or blanks are not found here and there; and these breaks in the continuous forest provide the variety of plants and food which enable a large number of bird species to live. In the Sal Forest there is some change in that there are many more borers in sal (*Shorea robusta*) and the rougher bark provides cover for bark haunting insects, so that in sal forests there are more woodpeckers, nuthatches, etc. A more profound change is often brought about by the forest officer in creating pure plantations of teak etc., but so far these are not on a sufficiently large scale or so continuous as to change the bird population markedly.

In the higher hills of the Satpuras conditions are cooler and moister, and to a certain extent do provide conditions in the hot weather which are favourable to birds which live in slightly moister conditions than are usual in the dry deciduous forests. The characteristic species of the mixed deciduous forest are given below. By characteristic I mean birds which are found more in the forest than in other biotopes and are present in sufficient numbers to be significant in the biological sense :

1. Tree Pie, 2. Grey Tit, 3. Jungle Babbler, 4. Redvented Bulbul, 5. Magpie Robin, 6. Locally, the Shama, 7. Tickell's Blue Flycatcher, 8. Whitebrowed Fantail Flycatcher—locally replaced on hills by, 9. Whitespotted Fantail Flycatcher, 10. Wood Shrike, 11. Scarlet Minivet, 12. Small Minivet, 13. Large Cuckoo Shrike, 14. Black Drongo, 15. Whitebellied Drongo, 16. Racket-tailed Drongo, 17. Tailor Bird, 18. Blackheaded Oriole, 19. Greyheaded Myna, 20. Common Myna, 21. Yellowthroated Sparrow (as a breeding bird in February–May), 22. Tree Pipit in winter, 23. White-eye, 24. Purple Sunbird, 25. Flowerpecker, 26. Pitta (in May, June), 27. Mahratta Woodpecker, 28. Goldenbacked Woodpecker, 29. Large Green Barbet, 30. Crimsonbreasted Barbet, 31. Common Hawk Cuckoo, 32. Large Indian Parakeet, 33. Roseringed Parakeet, 34. Blossomheaded Parakeet, 35. Blue Jay, 36. Common Bee-eater, 37. Whitebreasted Kingfisher, 38. Common Grey Hornbill, 39. Common Indian Nightjar, 40. Jungle Nightjar, 41. Crested Serpent Eagle, 42. Crested Hawk Eagle, 43. White-eyed Buzzard,

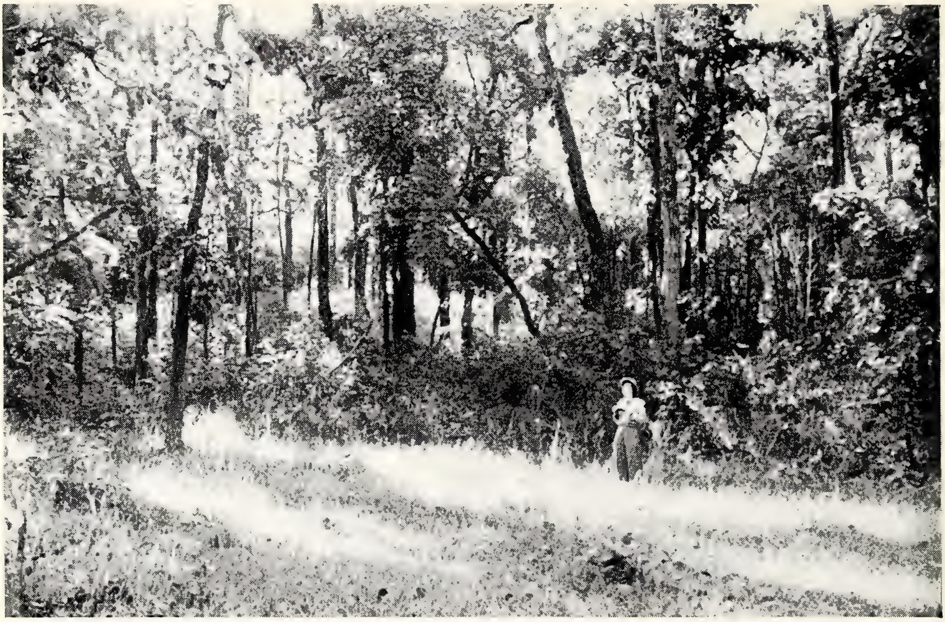


Closed Mixed Deciduous Forest before the leaves have fallen. Narainpur, Bastar.

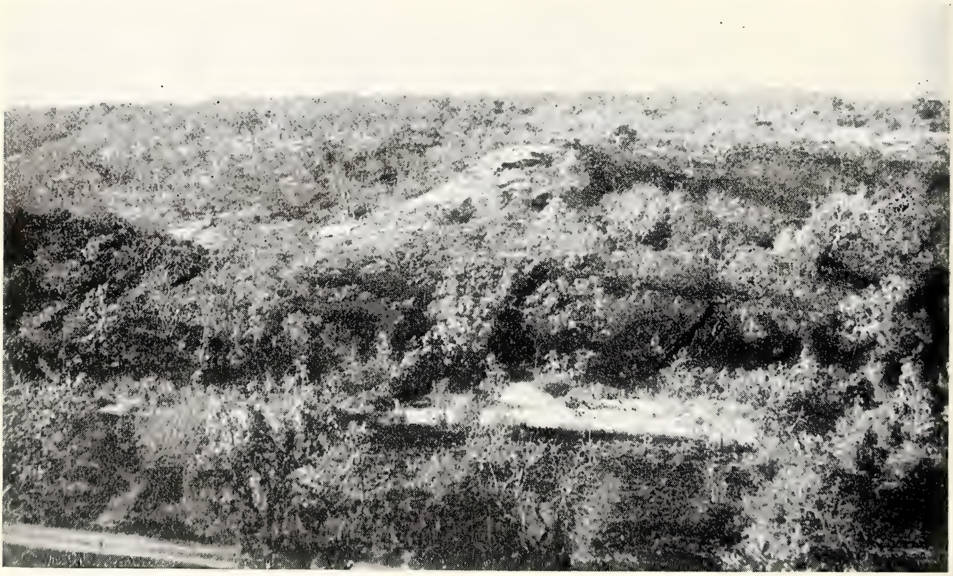


Closed Mixed Deciduous Forest in May with the trees mostly leafless. Melghat, Amravati.

(*Photos : C. E. Hewetson*)



Sal Forest with small blank. Narainpur, Bastar.



Mixed Deciduous Forest in drier climate in December. Akola, Berar.

(*Photos : C. E. Hewetson*)

44. Shikra ,45. Common Green Pigeon, 46. Spotted Dove, 47. Common Peafowl, 48. Grey Junglefowl in teak area, Red Junglefowl in sal forests, 49. Red Spurfowl, 50. Jungle Bush Quail, 51. Stone Curlew, 52. Redwattled Lapwing.

In addition a few species are characteristic of the moister type. They are local and do not occur in large numbers, but are interesting as indicating a linkage of birds found in SW. India with Assam, Burma and Malaya. Such are : 1. Velvetfronted Nuthatch, 2. Pied Shrike, 3. Nilgiri Blackbird, 4. Whistling Thrush, 5. Scimitar Babbler.

### B. Open Cultivation and Waste Lands

By this I mean lands which are nearly bare of trees and bushes except along the field boundaries; and the overgrazed waste land of villages. The characteristic birds are :

1. Common Babbler, 2. Large Grey Babbler, 3. Yelloweyed Babbler, 4. Pied Bushchat, 5. Stonechat, 6. Indian Robin, 7. Great Grey Shrike, 8. Baybacked Shrike, 9. Rufousbacked Shrike, 10. Black Drongo, 11. Tailor Bird, 12. Brahminy Myna, 13. Common Myna, 14. Locally, Bank Myna, 15. Locally, Pied Myna, 16. Baya Weaver Bird, 17. Whitethroated Munia, 18. Crested Bunting locally, 19. Indian Pipit, 20. Little Skylark, 21. Rufoustailed Lark, 22. Ashycrowned Finch Lark, 23. Blue Jay, 24. Green Bee-eater (except for August and September), 25. Hoopoe, 26. Pale Harrier, 27. Kestrel, 28. Blue Rock Pigeon, 29. Spotted Dove, 30. Indian Ring Dove, 31. Red Turtle Dove, 32. Common Quail, 33. Grey Partridge, 34. Stone Curlew, 35. Indian Courser, 36. Redwattled Lapwing, 37. Yellow-wattled Lapwing.

### C. Scrub Forest intermediate between A and B

By Scrub I mean the lands lying between the open treeless cultivation and the closed continuous forest. The amount of woody growth varies but typically there are at least scattered trees of mohwa (*Madhuca latifolia*), or Harra (*Terminalia chebula*) or tendu (*Diospyros melanoxylon*), and a proportion of coppice and bushes. This habitat is quite favourable to a number of species and the bird population is intermediate between A and B. Certain forest-loving species are absent but most of the birds of open cultivation can find open spaces.

It is not necessary to repeat the names of the birds.

### D. Reservoirs and Irrigation lakes or ponds (tanks)

Lakes, Reservoirs, or Tanks are of all sizes from expanses of water covering thousands of acres to village ponds under one acre. The greater part of big lakes with deep water are more or less useless to birds for feeding, but they may rest on them. It is the silted-up edges of the tanks, the water of moderate depth with weeds growing below the surface which provide the optimum habitat for water birds. The plants found depend on the depth of water, and the same succession is found round most tanks.

The characteristic birds which feed here mainly or completely are :

1. Wiretailed Swallow, 2. Yellow Wagtail, 3. Large Pied Wagtail, 4. White Wagtail, 5. Common Bee-eater, 6. Pied Kingfisher, 7. Common Kingfisher, 8. Whitebreasted Kingfisher, 9. Hoopoe, 10. Brahminy Kite, 11. Fishing Eagle, 12. Coot, 13. Bronzewinged Jaçana, 14. Pheasant-tailed

Jaçana, 15. Sarus Crane, 16. River Tern, 17. Redwattled Lapwing, 18. Blackwinged Stilt, 19. Wood Sandpiper, 20. Common Sandpiper, 21. Green Sandpiper, 22. Greenshank, 23. Little Stint, 24. Common Snipe, 25. Little Cormorant, 26. Snake Bird, 27. White Ibis, 28. Black Ibis, 29. Whitenecked Stork, 30. Painted Stork, 31. Openbilled Stork, 32. Grey Heron, 33. Little Egret, 34. Cattle Egret, 35. Paddy Bird, 36. Nukta, 37. Cotton Teal, 38. Common Teal, 39. Garganey, 40. Pintail, 41. Spotbill, 42. Shoveller, 43. White-eyed Pochard, 44. Little Grebe.

### E. River Beds

In this biotope I include both the broad, often sandy, beds of large rivers like the Narmada or Mahanadi as well as beds of smaller nalas which hold water. The nala beds may be divided into several sub-types:

(1) Bare sandy beds with deep pools.
(2) Rocky beds or rock and sand with bushes of tamarisk etc. and small trees.
(3) The banks which may be bare, or covered by trees like *Terminalia arjuna* and *Syzygium cumini* with varying amounts of bush and scrub.

Each section of the bed is the province of one species or a group of birds, and every niche is fully exploited. Characteristic species are:

1. Large Pied Wagtail, 2. Sand-Lark, 3. Pied Kingfisher, 4. Common Kingfisher, 5. Whitebreasted Kingfisher, 6. Brownheaded Storkbilled Kingfisher, 7. Brown Fish Owl, 8. Brahminy Kite, 9. Great Stone Plover, 10. River Tern, 11. Whiskered Tern, 12. Blackbellied Tern, 13. Little Tern, 14. Indian Skimmer, 15. Little Indian Pratincole, 16. Redwattled Lapwing, 17. Spurwinged Plover, 18. Little Ring Plover, 19. Common Sandpiper, 20. Green Sandpiper, 21. Wood Sandpiper, 22. Greenshank, 23. Little Stint, 24. Little Cormorant, 25. Common Cormorant, 26. Indian Snake Bird, 27. Barheaded Goose, 28. Ruddy Sheldrake.

## BIRD MOVEMENTS

Apart from giving a picture of the pattern of the distribution of birds such a protracted study provides a good deal of information about bird movements. There are three main movements:

A. The migration of birds which nest outside India to the north, and are winter visitors.
B. The migration of certain species from south India in the summer for breeding.
C. Movements of the resident birds which are caused by the need to get food. These are not so regular or complete as the movements in B and C.

A. The first type of migration has already been described very fully in all books, the long distance winter migrants are well known, and it is not necessary to describe this here.

B. The second type of movement from south to north, or west to east, affects only a few species. They are, so far as is known at present:

1. Paradise Flycatcher, 2. Pitta. 3. Golden Oriole, 4. Southern Blackbird (*Turdus simillimus*), 5. Yellowthroated Sparrow, 6. Pied Crested Cuckoo, and perhaps other cuckoos.

Open Rice Fields with Babul (*Acacia arabica*) on the embankments.

Degraded open Grazing Grounds with bushes of Palas (*Butea frondosa*) and Hiwar (*Acacia leucophloea*). Ner, Yeotmal.

(*Photos : C. E. Hewetson*)

Houses, fruit trees, fields and scrub forest. Upaghat, Jashpur.

Junction of the Godavari and Indravati rivers in extreme south of the State.

(*Photos : C. E. Hewetson*)

C. The third type of movement is less regular and is connected with food supply rather than reproduction. Though some such movements take place each year, it is the exceptional years when they are emphasized and made obvious. In 1951 and 1952 the rains were deficient over a large part of the State and this led to a very big exodus of the insect-eating birds in 1953. Though as I say, this was exceptional, every year there is a thinning out of the birds in July to mid-September. In this period the bird population, both by species and numbers, is at its minimum. In the rains of 1953, following two years of drought over a large part of Western Madhya Pradesh, the birds left were mainly the seed eaters and those with a varied diet. The only pure insect eaters left were the Common Swift. The following is a list of birds which form the hard core of the resident population, and were still found during the rains of 1953 :

Crows, Sparrow, Indian Robin, Larks, Pipits, Doves, Common Swift, Mynas, Babblers.

Of the insect-eating birds, the bee-eaters and all species of flycatcher were absent completely. 95 per cent of the drongos had left, and rollers and shrikes were rare.

To my mind in 1954 and 1955 these last classes of birds were fewer than normal, and apart from the interruption in breeding caused by the drought and the exodus, there may have been a high mortality among this class of bird which do not normally migrate and may have had no ingrained knowledge of which direction to migrate in. The bee-eaters are more regular migrants and perhaps have regular rains quarters. These movements indicate that the insects on which the birds feed are also affected by the years of low rainfall : though insects seem plentiful in the rains, many of them are probably inedible : as far as bee-eaters are concerned it is known that the bees also migrate from the cold, damp areas such as the higher hills of the Satpuras in the height of the rains—and the bee-eaters certainly leave these areas each year, and as I said above, are much less common in the plains of Madhya Pradesh in the rains, and were completely absent in 1953, except for parties on migration.

## LOCAL POPULATIONS

The last observation leads me on to the subject of local populations and their significance. We are all familiar with flocks of migrating birds, and many birds in their winter quarters habitually roost together, such as swallows and wagtails in reed beds, but these are non-breeding birds and their association may be by mere chance, largely controlled by the small number of suitable roosts. Of the resident population, large assemblies of crows, parrots and mynas are familiar sights of any part of India. On a smaller scale many other resident species roost together at night. The bee-eaters are a well-known example. In the evening, the outlying birds start flying in, and as they go other birds join them and they all fly along together chirruping and gliding, and similar parties come in from all sides to roost together. The drongos to a certain extent do the same. The movement is less clear cut in the evenings since they feed into the dusk, but if one is out before dawn one will see no drongos, and after a time one sees them posting out to their daily beats. Another species I have observed is the Whitebacked Munia. These have dormitories, and one such was in a small palm tree near my bungalow in Raipur, and I used to watch the birds flying in from all sides in the evening with a strong swinging flight quite unlike their normal fluttering. It is interesting to speculate to what extent these local roosting parties represent distinct clans or populations which select mates within the colony and to which the young, when the breeding season is over, are taught to return. The thought that these roosting colonies are not chance assemblies but may have a more permanent link was suggested to me by seeing the parties of migrating bee-eaters in 1953. There were definite parties of 10-25 birds flying together in a very loose flock, hawking insects as they went, but flying in one definite direction and passing along without halting. If I had thought of this earlier it would have been instructive to plot the roosting centres in any one locality and to try and map the area covered during the day by the birds that roost together at night, and to see how many there are in one locality. The Blue-tailed Bee-eater is a very definite colonial species and one always sees a party of them together even during the day.

Similar group activities are suggested by species which form definite breeding colonies such as several species of swallows ; or detached colonies of such birds as Bank Mynas or the Grackle. These birds may be considered as the exact opposite of migrating species in as much as they stay attached to one restricted locality and fail to colonise the surrounding countryside which is equally suited to their requirements. Bank Mynas provide one of the best examples of discontinuous distribution in India and, considering they have such a varied diet and are quite strong on the wing, it is surprising how local and patchy their distribution is. Such detached groups must form, one would think, isolated populations that breed within the group. If this is true, varieties or sub-species could easily form in the same way as in bird populations of islands. Another species with very discontinuous distribution is the Emerald Dove. The small group which exists on the Balaghat-Mandla border must be separated by 200 miles from the birds in Bastar, which are the nearest group in Madhya Pradesh.

## PROBLEMS WORTH ATTENTION

I venture to set down a number of bird problems on which information is needed and where present knowledge is scanty or wanting. These hints may be of value to anyone who takes up the study of birds in central India, and wants to know where to start :

(*a*) Status of certain species which have not been recorded in recent years but which may occur, such as :

1. Great Indian Bustard, 2. Bluebreasted Quail, 3. Blewitt's Owl, 4. Blewitt's Painted Bush Quail, 5. Large Indian Pratincole, 6. Chestnut Bittern.

(*b*) Foster parents of the Indian Cuckoo (*C. micropterus*). It is curious that so little is known about this relatively common cuckoo. It is a very arboreal species and is sexually active at a time when birds which construct hammock nests at the ends of branches, such as drongos, the Paradise Flycatcher, orioles and minivets, are nesting, and these are the most likely hosts. Also other problems connected with all species of Indian parasitic cuckoos.

(*c*) The status of several cuckoos has not been determined. Several appear to be visitors in the months of May-July. For instance the

Cuckoo (*C. canorus*) has been recorded mostly in these months and acts as if breeding, but no eggs have been recorded from central India. The hosts are not known for certain either.

(*d*) Status of the Bluetailed Bee-eater. It may be a passage migrant in March-April and September : or may exist in small pockets in isolated localities.

(*e*) The Nilgiri Blackbird is another species which appears likely to be a migrant. It is very common, for instance in Chikalda in May, but I saw none in the rains or in the cold weather. It is possible the birds disperse into the Melghat as soon as the hot weather ends. It is also found in a number of isolated places along the Satpuras, but all my records are in the hot weather and rains. The migration of the Pitta is well established. The Paradise Flycatcher is also a migrant, but what proportion of birds breed regularly is uncertain : and whether any stay in central India all the year is doubtful.

(*f*) Another locally distributed species about which little is known is the Green Munia. It is a central Indian bird. It is very common in parts of the Melghat in March–May : another locality is Aheri–Allapalli from where it was recorded by Hume and again seen by me in 1949. Also parts of Bastar. Practically nothing has been recorded about its breeding.

(*g*) Very useful work could be done in recording the status of some of the larger birds which are most liable to become scarce or extinct as the country is opened up and the human population increases. The Great Indian Bustard may already have disappeared. The Sarus Crane is protected to a certain extent by religious sentiment but the breeding places may be cleared or disturbed. A census of the birds at 10-year intervals is the only way to check this. Many of the herons, storks etc. breed in colonies and can thus be enumerated fairly easily. The Painted Stork is a good example. Censuses of such birds are very useful.

(*h*) A field quite untapped in India is the usefulness or destructiveness of different species. We know very little about the diet of birds and to what extent they play an effective part in controlling insect pests.

(*i*) Resident ducks are another type of bird whose numbers might fall and the species disappear. The Spotbill is a good case, and a census of birds at 10-year intervals would be valuable.

In conclusion I summarize other papers which I could trace on bird life in central India so as to provide future workers with all the information available.

## LITERATURE

The earliest paper is one by R. C. H. Moss King (1911), ' The Resident Birds of Saugar and Damoh '.

This is based on a three-year period of duty and does not claim to be exhaustive. The author guarantees, however, that all the birds listed do breed in these districts. He lists 155 species. Out of these, only one, *Amaurornis akool*, the Brown Crake, does not appear in my list. He gives details of breeding dates for some species. I have included a number of these in my record with acknowledgements.

The second paper is by B.B. Osmaston on the Birds of Pachmarhi. He lists 135 species and the only unexpected bird is the Kokla or Wedge-tailed Green Pigeon (*Sphenocercus sphenurus*). He states he heard the very distinctive call, and in conversation at Oxford in 1955 he confirms this. It has not been recorded by anyone else.

In 1927, R. S. P. Bates contributed an article on Impressions of Pachmarhi Birds during his stay on a course. He gives details of birds seen breeding, but does not give any unusual birds.

In 1931, E. A. D'Abreu, Curator of the Nagpur Museum, published some notes on the Fauna of British India, which had just been completed, with reference to birds found in central India. He followed this up in 1935 with a list, which he tried to make as complete as possible, of all birds seen by him or received in the Museum or of which notes had been supplied by others. He also indicated birds which might occur but had not been recorded. In all he lists 430 birds of which 21 are different races so that 409 is the number of species. A large number of the birds given in his list, but not appearing in mine, are birds which *might* occur, or occasional stragglers. The following 23 species given by D'Abreu, which I have not recorded are worth mention as they may be found by future workers, and if one knows that their occurrence is possible one is more likely to be on the look-out for them:

1. Whiteheaded Babbler. *Turdoides striatus* (Dumont).
2. Purple Thrush. *Cochoa purpurea* Hodgs.
3. Rufous-tailed Flycatcher. *Alseonax ruficaudus* (Swainson).
4. Dark Grey Cuckoo Shrike. *Lalage melaschista* (Hodgs.).
5. Starling. *Sturnus vulgaris* Linn.
6. Whitecapped Bunting. *Emberiza stewarti* Blyth.
7. Blackheaded Wagtail. *Motacilla feldegg* Michahelles.
8. Himalayan Yellowbacked Sunbird. *Aethopyga siparaja* (Raffles).
9. Small Cuckoo. *Cuculus poliocephalus* Latham.
10. Indian Longtailed Nightjar. *Caprimulgus macrurus* Horsfield.
11. Grass Owl. *Tyto longimembris* (Jerdon).
12. Cinereous Vulture. *Aegypius monachus* (Linn.).
13. Small Indian Spotted Eagle. *Aquila pomarina hastata* (Lesson).
14. Himalayan Fishing Eagle. *Ichthyophaga nana* (Blyth).
15. Crested Goshawk. *Astur trivirgatus* (Temm. and Laug.).
16. Eastern Baillon's Crake. *Porzana pusilla* (Pallas).
17. Brown Crake. *Amaurornis akool* (Sykes).
18. Gullbilled Tern. *Gelochelidon nilotica* (Gmelin).
19. Eastern Golden Plover. *Pluvialis dominicus* (Muller).
20. The Ruff and Reeve. *Philomachus pugnax* (Linn.).
21. Glossy Ibis. *Plegadis falcinellus* (Linn.).
22. Tufted Duck. *Nyroca fuligula* (Linn.).
23. Eastern Goosander. *Mergus merganser* Linn.

In 1939, Sálim Ali published a paper on the Birds of Central India based on collections made in Dhar, Indore, Gwalior and Bhopal States as they then existed. These adjoin Madhya Pradesh to the west and north with a drier and more open type of country. He listed 278 species which more or less are the same birds as given in my list except that species of the moister forest are less, and birds of open country are more.

In 1939 the present writer contributed a paper on the Birds of the Betul District. This listed 158 species and gave the months in which they occurred. Betul district has few lakes and so the water birds are few.

In 1942, Mrs. Wright contributed a list of birds seen in Berar during one year. She names 193 species. She gives one unusual species, the Kentish Plover (*Leucopolius alexandrinus*) one of the far spreading winter migrants. She saw a number of birds of which I have no record or few, e.g., Brown Shrike, Starling, Wryneck and Tufted Duck. She saw the Grey Drongo in the Melghat in winter. She also records the Bluetailed Bee-eater as local, and saw a large flock on April 10 at Kamgaon tank and again in September. These are the months in which I have seen them also.

The following books and papers have been used by me in compiling this article:

### BOOKS

Fauna of British India. Birds, Vol. I–VIII, E. C. Stuart Baker.
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Popular Handbook of Indian Birds. 5th Ed. Hugh Whistler.
The Book of Indian Birds. 5th ed. Sálim Ali.
Indian Hill Birds. Sálim Ali.
The Birds of Travancore and Cochin. Sálim Ali.

### PAPERS

1. Moss King, R. C. H. (1911) : The Resident Birds of the Saugar and Damoh Districts, C.P. *JBNHS* **21** : 87–103.
2. Osmaston, B. B. (1921) : Birds of Pachmarhi, *JBNHS* **28** : 453–459.
3. Bates, R. S. P. (1927) : Impressions of Pachmarhi Birds, *JBNHS* **31** ; 918–931.
4. D'Abreu E. A. (1931) : Notes on the Fauna of British India. Birds, chiefly with reference to the Central Provinces, *JBNHS* **35** ; 217–219.
5. D'Abreu, E. A. (1935) : A list of the birds of the Central Provinces, *JBNHS* **38** ; 95–116.
6. Ali, Sálim (1939) : The Birds of Central India, *JBNHS* **41** : 82–106, 470-488.
7. Hewetson, C. E. (1939) : The Bird Year in Betul, *JBNHS* **41** : 286–310.
8. Wright, Mrs. M. D. (1942) : Notes on the Birds of Berar, *JBNHS* **43** : 428–445.

## ANNOTATED LIST

1. **Corvus macrorhynchus** Wagler. Jungle Crow

STATUS AND HABITAT : Resident—no abrupt changes noticed in numbers throughout the year. It is fairly closely confined to the forest, but may occur in villages or towns close to the forest.

GENERAL HABITS AND VOICE : They occur throughout the forest and arrive at a kill soon after it occurs. Communal roosts occur but perhaps not so well established as in the next species.

NESTING : March–May.

2. **Corvus splendens** Vieillot. Common House Crow

STATUS AND HABITAT : Resident. No seasonal changes in numbers recorded. Towns and cultivation, and on the edge of the forest.

NESTING. March–May.

3. **Dendrocitta rufa** (Latham). Indian Tree Pie

STATUS AND HABITAT : Resident. No local migrations noticed. Common in all forests, being one of the most constant species. Also occurs outside the forest wherever there are groves of trees.

GENERAL HABITS AND VOICE : The birds are usually in pairs but small parties also occur. Tree Pies and Racket-tailed Drongos frequently appear together. I do not know if their food-seeking is identical or complementary.

4. **Parus major** Linnaeus. Indian Grey Tit

STATUS AND HABITAT: Resident. One of the constant and regular members of the forest fauna. They occur in all forests.

GENERAL HABITS AND VOICE: They form part of the mixed hunting parties but are also found in small parties of their own. They are active and call frequently.

5. **Machlolophus xanthogenys** (Vigors). Yellowcheeked Tit

STATUS AND HABITAT: Resident. Found in all parts of the State in forest, gardens and open scrub country.

GENERAL HABITS AND VOICE: Similar to the preceding but more usually in pairs.

NESTING: Nests in June, Sagar (M.K.).

6. **Sitta castanea** Lesson. Chestnutbellied Nuthatch

STATUS AND HABITAT: Widely distributed but not common. Found here and there in old mango groves and sal forest. Resident.

7. **Sitta frontalis** Swainson. Velvetfronted Nuthatch

STATUS AND HABITAT: A locally distributed bird in certain hilly jungles. Satpura hills, Betul, Seoni, and common in the Bastar jungles.

GENERAL HABITS AND VOICE: Same as preceding.

8. **Turdoides somervillei** (Sykes). Jungle Babbler

STATUS AND HABITAT: One of the commonest and most regular resident species all over the State, particularly in the forest.

GENERAL HABITS AND VOICE: Bold and occurring in all localities in both forest and gardens and scrub.

NESTING: Rains.

9. **Argya caudata** (Dumont). Common Babbler

STATUS AND HABITAT: This is a bird of scrub growth in the fields and open village scrub, and is rare in the forest. Resident.

GENERAL HABITS AND VOICE: As recorded. A rather shy species.

NESTING: Rains.

10. **Argya malcolmi** (Sykes). Large Grey Babbler

STATUS AND HABITAT: This is a bird of the open country and occurs in the west of the State chiefly: Berar districts, Betul, Hoshangabad and Nimar. Not recorded in the east, i.e., Raipur and Chattisgarh, but boundary not exactly noted.

GENERAL HABITS AND VOICE: This strong and vigorous looking bird is typically found in open country and scrub jungle in the Berar plains. It is a noisy species. It occurs in garden compounds and is not shy.

NESTING: Rains.

11. **Pomatorhinus horsfieldii** Sykes. Deccan Scimitar Babbler

STATUS AND HABITAT: Comparatively a rare species found generally in the forest. Usually seen in pairs, but owing to its skulking habits may often be overlooked. I have recorded it chiefly in bamboo forest mainly in March to June. It may be partly migratory.

GENERAL HABITS AND VOICE : As recorded in books. Extremely elusive and difficult to watch.

12. **Dumetia hyperythra** (Franklin). Rufousbellied Babbler

STATUS AND HABITAT : Widely distributed throughout the State in open grassland and scrub. Owing to spending its life in this type of vegetation it is not often seen or noticed. It also occurs in the forest and is seen working bamboo clumps.

13. **Chrysomma sinensis** (Gmelin). Yelloweyed Babbler

STATUS AND HABITAT : Widely distributed all over the State in open scrub between fields and in village hedges. It clambers further up the vegetation than the previous species and provides chances to be observed. It is not a forest species.

14. **Pellorneum ruficeps** Swainson. Spotted Babbler

STATUS AND HABITAT : Only recorded in the Satpura hill ranges. Betul, Melghat. I believe it to be resident.

GENERAL HABITS AND VOICE : Feeds in dense undergrowth in deciduous forest and rarely seen. Presence more often deduced from the characteristic call.

15. **Alcippe poiocephala** (Jerdon). Quaker Babbler

STATUS AND HABITAT : Probably widely distributed in the more hilly parts of the State, in the forest. Recorded chiefly in the Satpuras.

GENERAL HABITS AND VOICE : Tree and shrub haunting bird.

16. **Aegithina tiphia** (Linnaeus). Common Iora

STATUS AND HABITAT : Widely distributed throughout the State in all types of country with trees. It occurs in all forests and in gardens and groves. Resident.

17. **Chloropsis jerdoni** (Blyth). Jerdon's Chloropsis or Leafbird

STATUS AND HABITAT : Widely distributed, being mainly seen in open country with trees but also sparingly in the forest.

GENERAL HABITS AND VOICE : Largely associated with plants of *Loranthus*, and most frequently seen feeding among flowers of this parasite. A very wide range of harsh calls, and also mimics other birds.

NESTING : Nests in June, Sagar (M.K.).

18. **Chloropsis aurifrons** (Temm. and Laug.). Goldfronted Chloropsis or Leafbird

STATUS AND HABITAT : As far as my records go, a rare species in central India. My records are all in the Satpuras, and I have identified it only four times.

19. **Molpastes cafer** (Linn.). Indian Redvented Bulbul

STATUS AND HABITAT : One of three most numerous and widely distributed birds of central India, being found in all types of vegetation even dense forest. Particularly abundant in lantana infested jungle of the Melghat.

NESTING: May–August.

20. **Pycnonotus jocosus** (Linnaeus). Redwhiskered Bulbul

STATUS AND HABITAT: Occurrence is discontinuous in central India. Most of the colonies are in the hills of the Satpuras or Bastar. It is a forest species but also occurs in hill stations such as Chikalda and Pachmarhi, where the forest comes up to the bungalows.

GENERAL HABITS AND VOICE: These are similar to the Redvented and the two species overlap in Chikalda. The Redwhiskered Bulbul is a wilder species in central India though it does come into the compound.

21. **Pycnonotus leucogenys** (Gray). The Whitecheeked Bulbul

STATUS AND HABITAT: I have never recorded this species in Madhya Pradesh but there are records from Sagar and Hoshangabad in the Fauna of B.I.

22. **Pycnonotus flaviventris** (Tickell). Blackcrested Yellow Bulbul

STATUS AND HABITAT: Seen by me only in Bastar District in sal and mixed forest. I saw parties each time I visited the Kanger Reserve.

GENERAL HABITS AND VOICE: They were seen flying up from trees as if hawking insects.

NESTING: Recorded by Osmaston near Pachmarhi.

23. **Pycnonotus luteolus** (Lesson). Whitebrowed Bulbul

STATUS AND HABITAT: This is not a common or widely distributed species as far as my records show. I have seen it in Chanda and Nagpur, commonly.

GENERAL HABITS AND VOICE: Seen in thick bushes and trees. Rather a skulking species compared with most bulbuls. Often detected by the calls.

[**Luscinia brunnea** (Hodgson). Indian Blue Chat

STATUS AND HABITAT: Never recorded by me in the State, but this bird breeds in the Himalayas and is recorded regularly as a winter visitor to the Nilgiris, but has not been recorded yet in central India.]

24. **Saxicola caprata** (Linnaeus). Pied Bushchat

STATUS AND HABITAT: A fairly regularly distributed species all over the State, but never common. Resident. Open fields particularly in black cotton soil country.

GENERAL HABITS AND VOICE: Lives and feeds in the cultivated and scrub lands. Hawks from any vantage point and also captures insects on the ground.

NESTING: April–May, in hollows or under clods in fields.

25. **Saxicola torquata** (Linnaeus). Stonechat

STATUS AND HABITAT: Winter visitor to the whole State. October–early March. Habitat similar to preceding.

GENERAL HABITS AND VOICE: General habits similar to preceding.

26. **Oenanthe picata** (Blyth). Pied Wheatear

STATUS AND HABITAT: Not recorded by me but they reach the west of the State.

27. **Oenanthe deserti** (Temminck). Desert Wheatear

STATUS AND HABITAT: Not recorded though known to occur up to Nagpur. The range and penetration of migrant birds must vary from year to year.

28. **Cercomela fusca** (Blyth). Brown Rock Chat

STATUS AND HABITAT: This species occurs commonly along the northern fringe of the State. I have recorded it in Hoshangabad town, Sagar, Damoh, but no further.

GENERAL HABITS AND VOICE: It stays in towns and ruined buildings and is quite unafraid of man. One family has been living in the Hoshangabad forest office for the last 10 years to my knowledge. The restricted range is curious as similar conditions occur all over the State.

NESTING: Rains for certain. Perhaps from April.

29. **Phoenicurus ochruros** (S. G. Gmelin). Black Redstart

STATUS AND HABITAT: A very punctual winter visitor. I have noted it on October 1 year after year. They leave again in the last week of March or first week of April. They are distributed fairly evenly both in towns and open deciduous forest all over the State.

GENERAL HABITS AND VOICE: Their niche in the bird community is closely similar to the Indian Robin and their arrival is rather resented by the robins.

30. **Cynosylvia suecica** (Linnaeus). Bluethroat

STATUS AND HABITAT: A winter visitor to the whole State but owing to its habitat being mainly in long grass and heavy reeds and its skulking habits, it is not easily seen. It is, however, common and widespread.

GENERAL HABITS AND VOICE: It is seen always on the ground and mostly near heavy grass and reeds, but when walking through they often fly up close to one's feet and the characteristic chestnut patch on the tail is conspicuous and leads to easy identification once one knows this.

[**Calliope calliope** (Pallas). Rubythroat

STATUS AND HABITAT: This species should occur at least in the east of the State in Bastar, but it has not been recorded by me.]

31. **Saxicoloides fulicata** (Linnaeus). Indian Robin

STATUS AND HABITAT: This is perhaps the most faithful resident species of the State. When the bird population is reduced to minimum in August–September, the robin will still be found in its own beat. The robin is found in the scrub and regular dry deciduous forest, as well as in gardens and fields.

GENERAL HABITS AND VOICE: It appears to be mostly an insect feeder and often takes ants. They have well defined beats and the males sing for territory, but round about bungalows the pairs seem to be permanent.

NESTING : April–July.

32. **Copsychus saularis** (Linnaeus). Magpie Robin

STATUS AND HABITAT : A regular resident species. It is often found well into the dry deciduous forest and is not confined to gardens etc. as is often suggested.

GENERAL HABITS AND VOICE : It is a ground feeding bird, but presumably in the forest has a fairly mixed diet. In the forest it is the commonest and perhaps the best songster.

NESTING : March to July.

33. **Kittacincla malabarica** (Scopoli). Shama

STATUS AND HABITAT : The bird is confined to one part of the State according to my notes. This is a narrow belt running more or less north-south from Balaghat through Bhandara into Bastar and Chanda districts. The forests are mixed deciduous with dense bamboo understorey ; there are other parts of the State with similar vegetation but I have not recorded it. The very striking and loud song, combined with the conspicuous colours, makes it unlikely that the bird would be missed wherever it occurs.

NESTING : No notes. The birds are in full song as early as March and up to May.

34. **Turdus simillimus** Jerdon. Nilgiri Blackbird

STATUS AND HABITAT : I am uncertain of the status of this bird. I have noted it at various places in the Satpuras from May to September. It is nowhere continuous and I have never seen a bird in the cold weather. Chikalda in the Melghat for instance, has a large population in May and up to the outbreak of the monsoon. By the end of June they are rare and by August none are left. It is possible they disperse and spread out in the forest and are not so obvious, but I have no record. I have seen colonies at Chikalda, Sajpur near Betul, Pachmarhi (Dhupgarh) and as far east as Surguja and Jashpur, all in the summer. I have no record of nesting but the cocks have been heard once singing at the end of June. They are not singing in May. Almost certainly they are not resident for the whole year. Bates (1927) records finding a blackbird's nest on Dhupgarh, Pachmarhi.

35. **Geokichla citrina** (Latham). Orangeheaded Ground Thrush

STATUS AND HABITAT: Resident and widely distributed but not common. They are usually found in fairly dense patches in the forest and are shy and difficult to observe ; but they are commoner than the casual observer would think.

GENERAL HABITS AND VOICE : They feed late into the evening and fly up into the trees when disturbed. The male's song is heard from May onwards and is strong and pleasant.

NESTING : Probably May–June.

36. **Monticola cinclorhyncha** (Vigors). Blueheaded Rock Thrush

STATUS AND HABITAT : An unusual winter visitor. I have recorded it only twice. Both times it was seen in the forest.

37. **Monticola solitaria** (Linnaeus). Blue Rock Thrush

STATUS AND HABITAT : A regular winter visitor to the whole State.

38. **Myiophoneus horsfieldii** Vigors. Whistling Thrush

STATUS AND HABITAT : Resident where found, but spreads into the plains in the rains and early winter. It is found at a number of places in the Satpuras besides Pachmarhi, e.g., Betul forests and as far east as the high plateaus in Surguja.

GENERAL HABITS AND VOICE : In the cold weather and summer it is found near the streams, but in the rains when every nala is a water course it flies about freely all over the Pachmarhi plateau. The song is heard from April onwards, but chiefly in June. The characteristic alarm call reveals its presence much more often than it is seen.

NESTING : Rains.

39. **Siphia parva** (Bechstein). Redbreasted Flycatcher

STATUS AND HABITAT : Regular winter visitor to the whole State—October to early April.

GENERAL HABITS AND VOICE : Generally in all types of country excluding the open fields. Its demands are similar to those of the resident Tickell's Flycatcher, and there is some resentment when the Redbreasted comes in. Its calls in winter are an impatient *chik*.

40. **Muscicapula tickelliae** (Blyth). Tickell's Blue Flycatcher

STATUS AND HABITAT : Resident and widely distributed in the forest areas of the State. It is one of the species which may be found in the densest deciduous forest. One of our most typical forest species.

NESTING : July–September.

41. **Muscicapula superciliaris** Jerdon. White-eyebrowed Blue Flycatcher

STATUS AND HABITAT : Occasional winter visitor but probably only a passage migrant. Only recorded end of January or February.

42. **Eumyias thalassina** (Swainson). Verditer Flycatcher

STATUS AND HABITAT : A winter visitor but recorded by me only from the hill districts of the Satpuras such as Chikalda—Betul.

GENERAL HABITS AND VOICE : Hawking insects from the tops of trees and bushes.

43. **Culicicapa ceylonensis** (Swainson). Greyheaded Flycatcher

STATUS AND HABITAT : One of the commonest and most widely spread small resident birds being particularly common in dense wild mango trees along nalas in the hills.

GENERAL HABITS AND VOICE : The cheerful little song may be heard nearly the whole year.

44. **Tchitrea paradisi** (Linnaeus). Paradise Flycatcher

STATUS AND HABITAT : Definitely a summer migrant though an occasional straggler may be seen in the winter. They arrive in the last week of March and are common until the rains break when many birds move on. A few nesting birds may stay on throughout the rains, but most nests seem to be broken up by the monsoon winds and rain

A garden bird, and also in forest particularly along nalas which retain water. The numbers of birds vary from year to year. 1955 was a bad year.

NESTING: May–June.

45. **Alseonax latirostris** (Raffles). Brown Flycatcher

STATUS AND HABITAT: Recorded by me only in the Melghat where it is common at present. I may have missed it in the adjacent Betul forests which are similar, but I doubt that I could have failed to see it in five years spent in Betul. Presumably resident, but my records are all in the period April–June.

GENERAL HABITS AND VOICE: A bird of the mixed deciduous forests hawking insects in the crowns of the trees and understorey.

NESTING: No notes. Sálim Ali (1939) furnishes evidence of its breeding in central India.

46. **Hypothymis azurea** (Boddaert). Blacknaped Flycatcher

STATUS AND HABITAT: One of the regular resident birds of the mixed deciduous forest. Perhaps not so numerous as Tickell's and the Greyheaded Flycatchers, but characteristic.

GENERAL HABITS AND VOICE: Typical flycatcher. Nothing special to record.

47. **Leucocirca aureola** (Lesson). Whitebrowed Fantail Flycatcher

STATUS AND HABITAT: One of the commonest and most widely spread birds of the State, found in all places where there are some trees and woody growth.

NESTING: April–June.

48. **Leucocirca pectoralis** Jerdon. Whitespotted Fantail Flycatcher

STATUS AND HABITAT: This bird which is so similar in its habits to the last is not widely distributed but has been recorded by me only from the western hill ranges such as Chikalda, Pachmarhi and the higher parts of Betul.

NESTING: April–June.

49. **Lanius excubitor** Linnaeus. Great Grey Shrike

STATUS AND HABITAT: A resident bird confined to only a small part of the State and never common. My records are only from the drier western parts where the thorny trees are characteristic.

NESTING: Nests in March–April in Sagar (M.K.).

50. **Lanius vittatus** Valenciennes. Baybacked Shrike

STATUS AND HABITAT: Resident and found commonly all over the State in all types of country except dense forest.

GENERAL HABITS AND VOICE: It is not a bird exclusively of the dry parts with thorny trees, but is also found in quite well-watered forest.

NESTING: June–August.

51. **Lanius cristatus** Linnaeus. Brown Shrike

STATUS AND HABITAT: Though this species should occur in Madhya Pradesh, it has never been recorded by me. Mrs. Wright has recorded it in Berar.

52. **Lanius schach** Linnaeus. Rufousbacked Shrike

STATUS AND HABITAT : A resident and widely distributed species in all parts of the State except dense forest.

NESTING. April–July.

53. **Lanius nigriceps** (Franklin). Blackheaded Shrike

STATUS AND HABITAT : Though recorded in Whistler's Handbook as found in Nagpur, I have no record. D'Abreu records it from Bastar, Bilaspur and Nagpur. It is a Himalayan bird particularly common in Assam. It is not recorded from central India in Stuart Baker.

54. **Hemipus picatus** (Sykes). Pied Shrike

STATUS AND HABITAT : A resident species distributed patchily in the Satpura Hills and Bastar State. It is not common, but I have recorded it 2–3 times a year.

GENERAL HABITS AND VOICE : An inhabitant of hill forest in the Satpuras recorded by me many times in Betul and Hoshangabad, and latterly Bastar. Usually in pairs or small parties.

NESTING : Nests in June–July in Sagar (M.K.).

55. **Tephrodornis pondicerianus** (Gmelin). Common Wood Shrike

STATUS AND HABITAT : Resident and common in all forests in the State and in well-treed localities in towns and villages.

NESTING : Nests in June–July in Sagar (M.K.).

56. **Pericrocotus flammeus** (Forster). Scarlet Minivet

STATUS AND HABITAT : This is a regular resident bird of the better quality forests in the State such as the Bori Valley in Hoshangabad and the Bastar sal forests.

GENERAL HABITS AND VOICE : It is an arboreal bird and is seldom seen less than 20 feet from the ground. The males have a superb courtship flight above the tree tops in April and May.

NESTING : No record, but presumably in April–June.

57. **Pericrocotus brevirostris** (Vigors). Shortbilled Minivet

STATUS AND HABITAT : Though I cannot distinguish this species from the preceding with certainty, it is a winter visitor to the State in all probability.

GENERAL HABITS AND VOICE : Same as preceding.

58. **Pericrocotus cinnamomeus** (Linnaeus). Little Minivet

STATUS AND HABITAT : This is one of the commonest species of the forest and wherever there are avenues or groves of trees in the cultivation. It is resident and occurs all over the State.

NESTING : Nests in April–May in Sagar (M.K.).

59. **Pericrocotus erythropygius** (Jerdon). Whitebellied Minivet

STATUS AND HABITAT : I am uncertain of the status of this species. For many years at a time I have not seen it at all. My records are mostly from Betul and the north-western portions. It may be an occasional winter visitor in exceptional years, or else a very local bird.

GENERAL HABITS AND VOICE : It is much more a bird of the open grassy country than the other minivets. The flocks keep fairly close together. It is probably a bird of dry thorn scrub forest to the NW. of Madhya Pradesh and at times moves into the better wooded parts of this State.

60. **Lalage sykesi** Strickland. Blackheaded Cuckoo Shrike

STATUS AND HABITAT : This is another species which from lack of adequate records I cannot fix the status of. I have not seen it often, and all my records are in March–April. This suggests a passage migrant, but my observations are quite inadequate.

61. **Graucalus macei** Lesson. Large Cuckoo Shrike

STATUS AND HABITAT : A common and well-distributed species occurring all over the State. Resident as far as I know.

GENERAL HABITS AND VOICE : A bird of the tree tops and usually seen flying at the tree top level; in pairs or several birds in a loose party. They call frequently with a typical long *tee-hee* whistle.

62. **Artamus fuscus** Vieillot. Ashy Swallow Shrike

STATUS AND HABITAT : Though this is a species which might be expected to occur regularly in the State, I have only two records, each time in January–February, once in Betul in the Tapti Valley and once in the Kanger Valley in Bastar.

GENERAL HABITS AND VOICE : Nothing beyond what is recorded in books. Since parties of this bird are very prominent and cannot be missed I feel fairly certain that it is extremely rare to absent all over the State.

63. **Dicrurus macrocercus** Vieillot. Black Drongo

STATUS AND HABITAT : One of the commonest and most faithfully resident birds of the State.

GENERAL HABITS AND VOICE : This drongo occurs in all types of country from open fields to dense forest, though in the forest it tends to be replaced by *D. caerulescens*. The birds of one locality roost together and may be seen in the early morning posting back to their beats.

NESTING : April–May.

64. **Dicrurus longicaudatus** Jerdon. Indian Grey Drongo

STATUS AND HABITAT : I regret my failure after so many years to be able to distinguish this species in the field from the preceding. My observations on this species must therefore be guarded. It is a winter visitor and usually seen in the hills. This is the sum of my observations. I write, however, subject to correction.

65. **Dicrurus caerulescens** (Linnaeus). Whitebellied Drongo

STATUS AND HABITAT : A regular resident species of the forest. It is definitely a forest denizen and is an arboreal species.

GENERAL HABITS AND VOICE : Similar to other drongos, except it is seldom seen on the ground. It has a wide range of calls more melodious than the Black Drongo.

NESTING : April–May.

66. **Chibia hottentotta** (Linnaeus). Haircrested Drongo

STATUS AND HABITAT: A very locally distributed bird to the best of my knowledge; only seen in Bastar from where it has been recorded by other forest workers too.

67. **Dissemurus paradiseus** (Linnaeus). Large Racket-tailed Drongo

STATUS AND HABITAT: A resident of the denser bamboo forests of the State, being widely distributed. It is not uncommon.

GENERAL HABITS AND VOICE: This fine drongo is often associated with tree pies. It is famous for the variety of its calls. They fly through the forest and do not seem to have a beat within which they hawk insects and return to the same place.

68. **Acrocephalus stentoreus brunnescens** (Jerdon). Indian Great Reed Warbler

STATUS AND HABITAT: Almost certainly occurs but no confirmed record.

69. **Acrocephalus dumetorum** Blyth. Blyth's Reed Warbler

STATUS AND HABITAT: This occurs but I have no certain records.

[**Acrocephalus agricola** (Jerdon). The Paddyfield Warbler, may also occur.]

[**Hippolais scita** (Eversman). Booted Warbler. No record but probably occurs.]

70. **Orthotomus sutorius** (Pennant). Tailor Bird

STATUS AND HABITAT: Common and resident throughout the State in all types of country including the mixed deciduous forest.

GENERAL HABITS AND VOICE: A busy bustling noisy bird producing an astonishing volume of song for such a small size. Common in a great range of different types of country.

NESTING: June–August.

71. **Cisticola juncidis** (Rafinesque). Fantail-Warbler

STATUS AND HABITAT: Certainly occurs but no confirmed record. Osmaston records *C. cursitans* at Pachmarhi.

72. **Franklinia buchanani** (Blyth). Rufousfronted Wren-Warbler

STATUS AND HABITAT: Occurs in the State and recorded in the west and north-west: Little else noted.

NESTING: Nests in July in Sagar (M.K.).

73. **Franklinia gracilis** (Franklin). Franklin's Wren-Warbler

Recorded by Osmaston at Pachmarhi.

74. **Sylvia curruca** (Linnaeus). Lesser Whitethroat

STATUS AND HABITAT: Occurs regularly in the winter; in trees etc.

75. **Phylloscopus collybitus** (Vieillot). Chiff-Chaff

STATUS AND HABITAT: This and related forms occur in the winter, e.g., *P. griseolus* was recorded by Osmaston at Pachmarhi.

76. **Acanthopneuste occipitalis** (Blyth). Large Crowned Willow-Warbler

STATUS AND HABITAT: Certainly occurs regularly in the winter and is seen all over the forest as well as more open country.

77. **Prinia socialis** (Sykes). Ashy Wren-Warbler

STATUS AND HABITAT: This is one of the common and regular resident breeding species.

GENERAL HABITS AND VOICE: Occurs in cultivation and scrub jungle and gardens.

NESTING: June–July.

78. **Prinia sylvatica** Jerdon. Jungle Wren-Warbler

NESTING: Nests in July in Sagar (M.K.).

79. **Prinia inornata** Sykes. Indian Wren-Warbler

STATUS AND HABITAT: Occurs but no certain notes.

NESTING: Nests in July in Sagar (M.K.).

80. **Oriolus oriolus** (Linnaeus). Golden Oriole

STATUS AND HABITAT: Though this species is seen all the year, there certainly are many more birds in the period March-July.

GENERAL HABITS AND VOICE: This is a bird of open country though it does also occur in the forest, as opposed to the next species which is more of a forest dweller.

NESTING: April-June.

81. **Oriolus xanthornus** (Linnaeus). Blackheaded Oriole

STATUS AND HABITAT: A resident species and typical of the dry deciduous or sal forests. It is common and occurs in all except the driest forests.

GENERAL HABITS AND VOICE: Similar to the preceding but especially in forest trees.

NESTING: April–June.

82. **Gracula religiosa** (Linnaeus). Indian Grackle

STATUS AND HABITAT: A bird confined to only one area in the State according to my notes, i.e., Bastar State in the Kanger Valley and other parts of the plateau. It is curious that such a strong flying bird does not spread into new localities which are equally well suited, but this immobility seems to be typical of several species of myna.

GENERAL HABITS AND VOICE: A bird of tall tree forest, never visiting the ground.

NESTING: February to May but also after the rains in October.

83. **Pastor roseus** (Linnaeus). Rosy Pastor

STATUS AND HABITAT: An irregular migrant species which may or may not be seen in any one year, and whose numbers vary greatly in different years. Usually seen in Madhya Pradesh from January to March.

GENERAL HABITS AND VOICE: It appears to be a passage migrant and does not settle down in one locality.

84. **Sturnia malabarica** (Gmelin). Greyheaded Myna

STATUS AND HABITAT: Though some birds may be seen in all months of the year it is also a migratory species and flocks may be seen on passage in February-March.

GENERAL HABITS AND VOICE: A tree-feeding species in the main and much shyer and less bold than most mynas.

85. **Temenuchus pagodarum** (Gmelin). Brahminy Myna

STATUS AND HABITAT: One of the widely distributed and resident mynas; though not usually common it may be looked for in all parts of the State both in forest and open country.

GENERAL HABITS AND VOICE: Similar to the Common Myna, but it does not come into houses to nest and is generally less bold. It is rather intermediate between the tree mynas and the ground feeders.

NESTING: No record but probably rains.

86. **Acridotheres tristis** (Linnaeus). Common Myna

STATUS AND HABITAT: Abundant and resident. Probably the commonest bird in the State.

GENERAL HABITS AND VOICE: Often chooses railway stations for its communal roosts.

NESTING: March–July. Very fond of buildings, but in the forest uses holes in trees.

87. **Acridotheres ginginianus** (Latham). Bank Myna

STATUS AND HABITAT: In Madhya Pradesh very patchily distributed, but very faithful to the localities where it is found. I know of one colony, on the Katni-Burhi road in Jabalpur district, which I noted in 1937 and found the birds still in this restricted place in 1955. They have a breeding colony in the high banks of the river Mahanadi. Another colony is west of Harda. I have not recorded it elsewhere in the State though there must be other isolated colonies.

NESTING: April–May.

88. **Aethiopsar fuscus** (Wagler). Jungle Myna

STATUS AND HABITAT: Though this bird might be expected to be found all over the hill ranges of Madhya Pradesh, I have only seen it once in my 28 years, and that on the Pandrapat plateau at 3,500 ft. on the Jashpur-Surguja border. I am pretty sure it does not occur elsewhere as on this occasion I spotted the identity at once without binoculars and I feel I could never have missed it by confusion with any other species of myna. It is to be considered as very rare or occasional.

GRNERAL HABITS AND VOICE: Appears to be a tree species and not similar in habits to the Common Myna.

89. **Sturnopastor contra** Linnaeus. Pied Myna

STATUS AND HABITAT: This is another myna with a very restricted and patchy distribution. It is common in the Bhandara and Balaghat districts, and sporadically in Raipur and the eastern districts.

GENERAL HABITS AND VOICE: A ground feeding myna of open country and not a forest bird.

NESTING: April–July.

90. **Ploceus philippinus** (Linnaeus). Baya Weaver Bird

STATUS AND HABITAT: Obvious in rains when they are breeding and the males are conspicuous. I have also recorded them occasionally in the cold weather, but whether absence of records in the hot weather means that the birds migrate or are inconspicuous and one misses them, I am uncertain.

GENERAL HABITS AND VOICE: Usually in dense parties in the cold weather; and in the breeding season in the rains as described.

NESTING: July–September. Nests are usually suspended from palm trees or Babul (*Acacia arabica*).

91. **Uroloncha malabarica** (Linnaeus). Whitethroated Munia

STATUS AND HABITAT: Resident and numerous in nearly all parts of the State. Though usually associated with open cultivation it also occurs in the forests.

GENERAL HABITS AND VOICE: Often seen in fluttering small parties, and this is the usual impression, but they are also capable of a fine, strong, swinging flight as for instance when individuals return to the 'family' dormitory in the evenings from their foraging.

NESTING: Probably in any month.

92. **Uroloncha striata** (Linnaeus). Whitebacked Munia

STATUS AND HABITAT: This is not so common, nor so evenly distributed as the last species. It is more often observed in light forest areas, than in the open cultivation. I would call it occasional and patchily distributed.

GENERAL HABITS AND VOICE: Usually in close parties that feed together in the forest and soon disappear so that one can never keep them under observation for long. It is surprising how quickly a flock can be lost to sight.

93. **Uroloncha punctulata** (Linnaeus). Spotted Munia

STATUS AND HABITAT: Occasional flocks are observed but it is not common or often seen. Resident.

GENERAL HABITS AND VOICE: Nothing on record except usually seen in grass land.

94. **Munia malacca** (Linnaeus). Blackheaded Munia

STATUS AND HABITAT: No certain record but I think I have seen it in Bastar. Bates has recorded it from Pachmarhi.

95. **Amandava amandava** (Linnaeus). Red Amadavat or Waxbill

STATUS AND HABITAT: Occasionally seen. Local.

96. **Stictospiza formosa** (Latham). Green Munia

STATUS AND HABITAT: This beautifully coloured little munia has a very erratic distribution but where it occurs it is abundant. Localities where I have seen it are Melghat (Chikalda in May only), Allapalli (Aheri) a locality noted in the Fauna, and parts of Bastar, e.g., Bailladilla Hill. Also in West Betul and Nimar.

GENERAL HABITS AND VOICE: Where found it is often seen in closely knit flocks containing 25–50 birds. They feed on the ground mostly and fly up into grass and low bushes when disturbed. They keep up a steady *tweet-tweet* which is distinctive as soon as learnt. Though the markings when seen are distinctive and pretty the birds soon merge with the background and are a uniform grey-green.

NESTING: No notes. Probably in July–August.

97. **Carpodacus erythrinus** (Pallas). Common Rosefinch

STATUS AND HABITAT: Best classed as a passage migrant in this State. I have seen it only in January–February and usually not for many days. I have not seen the birds in October–November.

GENERAL HABITS AND VOICE: Usually in cultivation but also seen in the forest.

98. **Gymnorhis xanthocollis** (Burton). Yellowthroated Sparrow

STATUS AND HABITAT: This is one of the strongest marked internal migrants. Flocks of birds become common in January and split up into breeding pairs in March–April when the forests resound with the chirpings of these sparrows. By the end of May the flocks are re-forming and the great majority of birds leave with the rains. Some flocks may perhaps be seen between July and December, but this is the main movement.

GENERAL HABITS AND VOICE: As a breeding bird this sparrow is a forest dweller and the whole of our forests are occupied: in aggregate a vast number of birds. Not all birds seem to pair, and there are always a number dashing about. This bird is very strong on the wing and birds chase each other swiftly. They appear to be ground feeding. In March–April our forests are at the barest, most trees being leafless, but I regret I have no records of what the nestlings are fed on.

NESTING: March–May.

99. **Passer domesticus** (Linnaeus). House Sparrow

STATUS AND HABITAT: Common and resident.

NESTING: All the year—main period is perhaps August–October.

100. **Emberiza striolata** Lichtenstein. Striolated Bunting

STATUS AND HABITAT: I have recorded it only twice, in dry forests in Betul. It is an unobtrusive bird and may easily be missed. It is recorded from Sagar and may occur in the north and west of the State.

101. **Emberiza buchanani** Blyth. Greynecked Bunting

STATUS AND HABITAT: A winter visitor to parts of Madhya Pradesh, but recorded by me only in the Wadali Hills near Amravati. Mrs. Wright has also recorded it in her birds of Berar.

GENERAL HABITS AND VOICE: It is seen in small parties on the ground in scrub forest.

102. **Emberiza melanocephala** Scopoli. Blackheaded Bunting or
**Emberiza bruniceps** (Brandt). Redheaded Bunting

STATUS AND HABITAT: Occasional passage migrants usually recorded in January to March. Many years pass without any record. I am not sure which species occurs and observers should try to check this point.

GENERAL HABITS AND VOICE : The birds are usually associated with the ripening crops. They are found in small loosely aggregated flocks and fly up into trees when disturbed.

103. **Melophus lathami** (Gray). Crested Bunting

STATUS AND HABITAT : Status uncertain. I have found it mostly in the west of the State particularly in Betul, Amravati and Nimar. One never sees it in the east. The numbers vary from year to year and by seasons which suggests local movements as well.

GENERAL HABITS AND VOICE : In small parties in fairly open country and usually feeding on the ground.

104. **Riparia paludicola** (Vieillot). Indian Sand Martin

STATUS AND HABITAT : Common and resident in all parts of the State.

NESTING : Probably January–March.

105. **Riparia concolor** (Sykes). Dusky Crag Martin

STATUS AND HABITAT : Found in hilly localities in all parts of the State in small numbers.

106. **Hirundo smithii** Leach. Wiretailed Swallow

STATUS AND HABITAT : A resident species in the main in Madhya Pradesh; at least birds are seen in all months of the year.

GENERAL HABITS AND VOICE : It is usually found near water all over the State. Nothing exceptional is noted.

NESTING : Probably April–August.

107. **Hirundo daurica** Linnaeus. Redrumped Swallow

STATUS AND HABITAT : In some ways this is difficult to assess. Some are undoubtedly resident and are found in hill ranges in the summer, but there is a great increase in numbers in the winter. The main season is in January and February when large flocks of this species and *H. rustica* may be seen together.

GENERAL HABITS AND VOICE : The resident hill birds behave more like Crag Martins, but the immigrants in the plains are typical swallows in their habits.

NESTING : Probably rains.

108. **Hirundo rustica** Linnaeus. European Swallow

STATUS AND HABITAT : A winter migrant usually seen in January and February.

109. **Motacilla alba** Linnaeus. White Wagtail

STATUS AND HABITAT : Both a passage migrant and a winter resident. The birds appear in large numbers in the middle of October but soon become less. During the rest of the cold weather they are distributed patchily and seem to move about a lot.

GENERAL HABITS AND VOICE : On first arrival they are in small flocks and very strong on the wing. The return migration does not seem to pass through this State in large numbers.

110. **Motacilla maderaspatensis** Gmelin. Large Pied Wagtail

STATUS AND HABITAT: Resident and widely distributed all over the State wherever there is water, on rivers, tanks and village ponds.

GENERAL HABITS AND VOICE: Feeds along the edge of the water. Bold in its nesting habits. One family has been using the Forest Rest House in Bori F.V. since 1938.

NESTING: In buildings etc. April–June.

111. **Motacilla cinerea** Tunstall. Grey Wagtail

STATUS AND HABITAT: A migrant species but one of the first species to arrive and the last to leave, so that the bird is absent only for May, June and July. Birds start to appear at the end of August, but in September they become more common.

GENERAL HABITS AND VOICE: Found all over the State particularly in forest areas, and in the cold weather one bird may be found in nearly every nala with water and also on roads near water. Also on nalas in more open country. The birds seem to occupy definite beats and will fly ahead up a nala as one goes along, but after a time will fly out into the forest and back into the nala behind one.

112. **Motacilla flava** Linnaeus. Yellow Wagtail

STATUS AND HABITAT: Passage migrant might be the best way to describe this bird. They are seen mostly from February onwards and are common in March each year. Individuals are seen in December–January but this is the main occurrence.

GENERAL HABITS AND VOICE: On marshy ground at the upper sides of tanks is the most usual, and in drying rice fields.

113. **Motacilla citreola** Pallas. Yellowheaded Wagtail

STATUS AND HABITAT: A rather scarcer bird than the preceding and also seen in February–March.

GENERAL HABITS AND VOICE: Feeds in the same places as the Yellow Wagtail.

114. **Anthus hodgsoni** Richmond. Indian Tree Pipit

STATUS AND HABITAT: Though rather doubtful about the exact identity of the birds seen, I presume that this species is the one seen in the cold weather. It is found in nearly all forests and is common. I am uncertain of the length of stay but I think it is from November to March.

GENERAL HABITS AND VOICE: Found mostly feeding on the ground inside the forest but also in open groves and gardens. They fly up into trees when disturbed.

115. **Anthus trivialis** Linnaeus. Tree Pipit

STATUS AND HABITAT: I have never succeeded in distinguishing this species from the previous one, but it may well occur.

116. **Anthus richardi rufulus** Vieillot. Indian Pipit

STATUS AND HABITAT: A common, resident species in all open country in the State. Often the only species in village waste land which has been grazed so heavily that little vegetation has been left.

NESTING: Probably mainly May, June, July.

117. **Anthus campestris** Linnaeus. Tawny Pipit

STATUS AND HABITAT: Not definitely identified by me but I have many times seen larger pipits than the resident species. These species are very difficult to identify in the field.

Also possibly *Anthus similis* (Brown Rock Pipit) and *Anthus richardi* (Richard's Pipit) may occur and must be looked for.

118. **Alauda gulgula** Franklin. Little Skylark

STATUS AND HABITAT: Resident and moderately common all over the State.

GENERAL HABITS AND VOICE: The song may be heard mostly in the cold weather.

NESTING: Presumably March-July, but the main song season is earlier.

119. **Calandrella brachydactyla** (Leisler). Short-toed Lark

STATUS AND HABITAT: A winter migrant species found in good sized flocks in all parts of the State. The birds are usually seen only in December and January. They feed and live in the open fields after harvest and on waste ground.

GENERAL HABITS AND VOICE: They are seen by an observer usually as a tight-knit, large flock which sweeps across the country in a swinging co-ordinated flight. When seen on the ground at a short distance they feed closely together, but soon get lost as they merge so quickly with the bare ground.

120. **Calandrella acutirostris** Hume. Yarkand Short-toed Lark

STATUS AND HABITAT: Not recognized separately by me, but it may well occur, or this may be the common species (see Sálim Ali, 1939).

121. **Alaudula raytal** (Blyth). Sand-Lark

STATUS AND HABITAT: This is resident and found near water. I particularly associate it with the banks of the Narmada River.

GENERAL HABITS AND VOICE: It is always found close to water.

122. **Mirafra assamica** Horsfield. Bengal Bush Lark

STATUS AND HABITAT: Not recorded with any certainty though it should occur in the State. This is due to the difficulty in identifying these species unless individuals are shot. I am also uncertain about the Singing Bush Lark (*Mirafra javanica*), and have no certain record.

NESTING: April and August-September in Sagar (M.K.).

123. **Mirafra erythroptera** Blyth. Redwinged Bush Lark

STATUS AND HABITAT: Resident and occasional.

124. **Galerida cristata** (Linnaeus). Crested Lark

STATUS AND HABITAT: Resident and fairly widely distributed in open country. *Galerida deva* also probably occurs but again not definitely identified.

125. **Ammomanes phoenicura** (Franklin). Rufoustailed Finch-Lark

STATUS AND HABITAT: This is one of the commonest and most widely distributed birds in the State in all open country. Usually in pairs or small parties. Resident.

GENERAL HABITS AND VOICE: Often one of the only bird species in the more desolate parts of the State. Overgrazed village wastes, potholed ground, between cultivation, etc. Its rather mournful calls are one of the typical sounds of these parts of the countryside.

126. **Eremopterix grisea** (Scopoli). Ashycrowned or Blackbellied Finch-Lark

STATUS AND HABITAT: Common and mostly resident but one often appears to find larger numbers at certain seasons so there may be local movements.

GENERAL HABITS AND VOICE: A bird of the open fallow land, often surprising one by the number of birds which spring up at one's feet from an apparently bare piece of ground. For small birds they are strong on the wing and the male appears to enjoy thoroughly his rising and falling song.

NESTING: No definite period. Nests in April and August-September in Sagar (M.K.).

127. **Zosterops palpebrosa** (Temminck). White-eye

STATUS AND HABITAT: Mostly resident and common to extremely common particularly in the slightly moister forests. Certainly one of the typical forest species.

GENERAL HABITS AND VOICE: A tree and bush haunting species; seen in small parties.

NESTING: April-June.

128. **Cinnyris asiaticus** (Latham). Purple Sunbird

STATUS AND HABITAT: This is the common sunbird of this State and is resident and found in all types of country. No other species of sunbird is found in most of Madhya Pradesh.

GENERAL HABITS AND VOICE: Males put on summer plumage from January, but the nesting season appears to be mostly from March to May.

NESTING: March to May seems to be the main season.

129. **Cinnyris zeylonicus** (Linnaeus). Purplerumped Sunbird

STATUS AND HABITAT: Though this species is shewn as occurring in the south of the State it is, as far as my experience goes, extremely scarce and I have only one record from the sal forests of South Raipur. In Sálim Ali (5th edition) it is recorded as not occurring north of the Godavari and this agrees with my observation.

130. **Dicaeum erythrorhynchum** (Latham). Tickell's Flowerpecker

STATUS AND HABITAT: Resident and fairly common in all parts of the State.

131. **Piprisoma agile** (Tickell). Thickbilled Flowerpecker

STATUS AND HABITAT: Presumably occurs but not identified by me as distinct from Tickell's Flowerpecker.

NESTING: Nests in March in Sagar (M.K.).

132. **Pitta brachyura** (Linnaeus). Indian Pitta

STATUS AND HABITAT: One of the well-marked summer migratory species of the State. The birds appear at the end of April and are common in suitable forest areas by May. The return migration is not so well-marked, but most birds have left by September, or it may be even earlier as one is not so much in the forest in the rains and opportunities to observe them are few.

GENERAL HABITS AND VOICE: They are generally seen in Madhya Pradesh in the denser and moister forest, and remain unknown even to forest officers. They feed much as thrushes and fly up into trees when disturbed. The forest is full of their emphatic calls in May and June.

NESTING: May-August.

133. **Picus vittatus xanthopygaeus** (Gray). Little Scalybellied Woodpecker

STATUS AND HABITAT: Resident species but not at all common and usually seen, according to my notes, in the Satpura Hills or on the Bastar plateau. Occasional and patchily distributed.

134. **Leiopicus mahrattensis** (Latham). Mahratta Woodpecker

STATUS AND HABITAT: Resident species and common all over the State. Together with the Goldenback the most common species of woodpecker in our forests.

NESTING: February-April.

135. **Yungipicus nanus hardwickii** (Jerdon). Indian Pygmy Woodpecker

STATUS AND HABITAT: Resident, but from observation not very common and usually seen in the more hilly forests. This may be due to the comparatively small and inconspicuous nature of the bird.

136. **Micropternus brachyurus** (Vieillot). Rufous Woodpecker

STATUS AND HABITAT: Resident, but as far as my notes go confined to the south of the State in Bastar and South Chanda. Common enough where found.

GENERAL HABITS AND VOICE: The species makes a surprisingly loud noise when drumming on trees.

NESTING: One nest found in May in Bastar from which a young bird flew.

137. **Brachypternus benghalensis** (Linnaeus). Goldenbacked Woodpecker

STATUS AND HABITAT: The commonest species of woodpecker found all over the State and fairly abundant everywhere. Easier to observe than most woodpeckers. It occurs equally in forest and more open tree-studded cultivation.

NESTING: February-May is the main season.

138. **Chrysocolaptes guttacristatus** (Tickell). Tickell's Goldenbacked Woodpecker.

STATUS AND HABITAT: Though recorded from the State I have not seen it for certain, and cannot confirm its occurrence. It is a bird of the Western Ghats but has been recorded from Chanda in Whistler. D'Abreu records it from Bhandara and Chanda.

139. **Chrysocolaptes festivus** (Boddaert). Blackbacked Woodpecker

STATUS AND HABITAT: The status and numbers of this species are uncertain as I have only once definitely seen it so clearly as to be able to identify it for certain, but I have many times seen a woodpecker which is not the Goldenback. However, as the bird seems to live permanently on the opposite side of the tree one can never be sure of the identity! Probably a very local species. Recorded by me only in Betul for certain.

GENERAL HABITS AND VOICE: As for other woodpeckers but very shy.

140. **Hemicircus canente** (Lesson). Heartspotted Woodpecker

STATUS AND HABITAT: A species found only in Bastar to my knowledge. There I have seen it once or twice. It was also recorded by Sálim Ali. Not common even in Bastar.

141. **Dryocopus javensis** (Jerdon). Great Black Woodpecker

STATUS AND HABITAT: This species also appears to be found only in Bastar. Specimens were secured to their surprise by Sálim Ali and Koelz, and I saw it in 3 or 4 places in Bastar when touring.

GENERAL HABITS AND VOICE: Usually in noisy parties in tops of trees. Their loud clanging calls are very arresting.

142. **Jynx torquilla** Linnaeus. Wryneck

STATUS AND HABITAT; A rare winter visitor, not seen by me but recorded by both D'Abreu and Mrs. Wright.

143. **Megalaima zeylanicus** (Gmelin). The Green Barbet

STATUS AND HABITAT: Common and resident all over the State and one of the commonest species in nearly all forests. It is also found outside in open country with trees.

GENERAL HABITS AND VOICE: An arboreal species which feeds mostly on figs etc., a bird which will be known to most only by the voice owing to the concealing coloration, but once one's eyes get used to picking it out, one will see it frequently.

NESTING: March-April.

144. **Megalaima haemacephala indica** (Latham). Coppersmith

STATUS AND HABITAT: Less of a forest species than the last one. It is equally common and resident, and found in all parts of the State wherever there are trees.

NESTING: March–April.

145. **Coracias benghalensis** (Linnaeus). Blue Jay

STATUS AND HABITAT: Common, resident and equally common all over the State. It penetrates into most of the forests and is more of a forest species than is usually said in books.

NESTING : Mostly May–June. The young usually are seen being fed in July–August.

146. **Merops orientalis** Latham. Green Bee-eater

STATUS AND HABITAT : Common and found all over the State. Normally to be counted as a resident but subject to considerable local movements. I had earlier noted that the birds left the colder hills of the Satpuras in the rains, but in 1953 following two years of low rainfall the entire population moved out in May–June and only returned in the first week of October. In June–July occasional parties of bee-eaters were seen but they were all on the move and keeping together. Probably in most years large numbers of bee-eaters do migrate, as numbers are obviously less in the rains and more in the cold weather.

GENERAL HABITS AND VOICE : Like many such birds the local population collect together to roost.

NESTING : February–May.

147. **Merops superciliosus** Linnaeus. Bluetailed Bee-eater

STATUS AND HABITAT : I have too few observations to decide its status in central India. It is common nowhere and not evenly distributed. My records are all in the months of February to April except for one in September. This may be mere coincidence or shows it is a passage migrant. I have always seen it near water. The localities I have seen it in are on the Indravati River between South Chanda and South Bastar, several individual birds on the Narmada at Hoshangabad ; once a party on the Mahanadi River near Katni at the same place as a colony of Bank Mynas (an association mentioned by Sálim Ali 5th edition); one party over the tank in the Chaugan Fort in Khairi Forest Range of Hoshangabad District ; and once near Nepanagar. These are the only occasions in 25 years of observation.

148. **Alcemerops athertoni** (Jardine and Selby). Bluebearded Bee-eater

STATUS AND HABITAT : A comparatively rare bird found in the hills round Pachmarhi, and also in Bastar. I have seen birds near Pachmarhi, at Bori and Churna in Bori Forest Range.

149. **Ceryle rudis** (Linnaeus). Pied Kingfisher

STATUS AND HABITAT : Resident and widely distributed. Wherever there are lakes or fairly large rivers with considerable pools of good depth. Not found in forest country usually.

NESTING : Probably main season December–April.

150. **Alcedo atthis** (Linnaeus). Common Kingfisher

STATUS AND HABITAT : Common, resident and widely distributed in all parts of the State wherever there are small streams and tanks.

GENERAL HABITS AND VOICE : This species is fairly adaptable and found in a wide variety of country. It is rather shy.

NESTING : March–May.

151. **Halcyon smyrnensis** (Linnaeus). Whitebreasted Kingfisher

STATUS AND HABITAT : Another common species particularly in the forests being independent of water and with a more varied diet. Resident all over the State, but particularly a forest bird.

GENERAL HABITS AND VOICE: This species is not immune from attacks by hawks and its bright plumage shows up when it is killed and plucked.

NESTING: March–June.

152. **Ramphalcyon capensis gurial** (Pearson). Storkbilled Kingfisher

STATUS AND HABITAT: This fine, large kingfisher is typically found along deep pools in the forest and has not been seen by me in any other habitat. It is locally distributed and not widespread. I have seen it most in Chanda District.

GENERAL HABITS AND VOICE: A rather noisy species calling a lot from dense foliaged trees along nalas. It flies strongly, but I have not seen it actually fishing.

153. **Tockus birostris** (Scopoli). Grey Hornbill

STATUS AND HABITAT: Common and resident all over the State, equally in the closed forest and the open treed countryside.

NESTING: March–April.

154. **Hydrocissa coronata** (Boddaert). Malabar Pied Hornbill

STATUS AND HABITAT: Found locally here and there in many parts of the State particularly in the denser forests and on the hills. Where it occurs it may be in considerable parties. I have seen it in Bori Valley (Hoshangabad), Ladi (Betul), Bastar, and it probably may be found in many other parts.

GENERAL HABITS AND VOICE: An extremely noisy bird usually in parties feeding in tall trees.

155. **Upupa epops ceylonensis** (Reichenbach). Hoopoe

STATUS AND HABITAT: Widely distributed and more or less resident. The distribution is irregular and numbers seem to vary, suggesting local movements. It is found in all open country but not usually inside dense forest.

NESTING: February to May.

156. **Harpactes fasciatus** (Pennant). Trogon

STATUS AND HABITAT: Only recorded from Bastar State where it appears to be fairly widespread. Probably will also be found in Sironcha range of South Chanda.

GENERAL HABITS AND VOICE: Only seen occasionally in ordinary types of forest, sitting silently inside the foliage of trees.

157. **Micropus affinis** (Gray). Indian Swift

STATUS AND HABITAT: Common and widespread and resident all over the State. The local colonies are usually based on some buildings, but the birds are also seen in the forest where they may nest on rocks etc.

GENERAL HABITS AND VOICE: This species was the only insectivorous bird which did not migrate in 1953 after the two years of drought.

NESTING: Probably mainly May–September.

158. **Micropus melba bakeri** (Hartert). Alpine Swift

STATUS AND HABITAT : Only two colonies are known in this State. There is one centred on Gawilgarh Fort in Chikalda (Amravati). These birds have been seen by me on several occasions ; I have also seen them from the top of Dhupgarh (Pachmarhi).

GENERAL HABITS AND VOICE : Tremendous speed and wonderful aerial display.

159. **Cypsiurus batassiensis** (Griffiths). Palm Swift

STATUS AND HABITAT : A very locally distributed bird as palms are not so common in this State. There is one colony in the large group of palms near the North Chanda forest office in Chanda town.

160. **Hemiprocne coronata** (Tickell). Indian Crested Swift

STATUS AND HABITAT : A very regularly distributed bird in nearly all the forests of the State and occasionally in well-treed localities in the more open tracts.

GENERAL HABITS AND VOICE : It hawks for insects above the trees. It comes down and skims the surface of the water to drink.

NESTING : February–March.

161. **Indicapus sylvaticus** (Blyth). Whiterumped Spinetail

STATUS AND HABITAT : This species is reported to occur in the State but I have never succeeded in identifying it. Sálim Ali in his Birds of Travancore and Cochin shows it as occurring in parts of Madhya Pradesh. D'Abreu records it as occurring from Nagpur to Seoni.

162. **Caprimulgus asiaticus** Latham. Indian Nightjar

STATUS AND HABITAT : A resident and widely distributed species all over the State particularly in non-forest areas.

GENERAL HABITS AND VOICE : They are particularly seen on roads and are often shown up in the headlights of cars.

NESTING : March–April.

163. **Caprimulgus indicus** Latham. Jungle Nightjar

STATUS AND HABITAT : Mostly a typical forest species though found in the open. Common all over the State.

*Note* : [Franklin's Nightjar (*Caprimulgus monticolus*) probably occurs but I have not succeeded in identifying it for certain.]

GENERAL HABITS AND VOICE : The *uk*, *kroo-kroo* call is attributed to this species, but my impression is that this call is heard only in hill forests and not in the plains where the Jungle Nightjar is certainly seen.

NESTING : March–April.

164. **Cuculus canorus** Linnaeus. Cuckoo

STATUS AND HABITAT : According to my records a migrant species which visits this State from early May to July or August : usually most are seen in June–July in the north. The numbers vary markedly from year to year ; for example in 1955 hardly a bird was seen or even heard.

GENERAL HABITS AND VOICE : It is a bird of the more open country presumably as the main fosterers are birds which breed in open country.

NESTING: Chiefly June–July. I am almost certain that this bird does breed in central India, but on consulting Stuart Baker's Nidification of Indian Birds, I see that no eggs have been recorded in central India.

165. **Cuculus micropterus** Gould. Indian Cuckoo

STATUS AND HABITAT: The status of this bird is still uncertain. I have only seen it at the same time as I have heard it, and as it is unobtrusive it is possible that in the rest of the year when it is silent one fails to spot it; but I would say it is a migrant and present from March in the south of the State, and from May in the north up to July or August.

GENERAL HABITS AND VOICE: This is typically a forest species though also found in more open country. It appears to be entirely arboreal and is usually seen in trees or flying above the forest canopy.

NESTING: Very little has been recorded. In the Nidification of Indian Birds, Stuart Baker says no information has been recorded except a possible connection with the drongos and the Paradise Flycatcher.

166. **Hierococcyx varius** (Vahl). Common Hawk-Cuckoo

STATUS AND HABITAT: This is the only parasitic cuckoo which I would agree is resident. It is common all over the State and in almost all types of country.

GENERAL HABITS AND VOICE: The Hawk-Cuckoo calls mostly from April to June, but if a spell of rainy weather occurs in the cold season it may call. It is mostly arboreal and is usually seen in trees. One often sees it flying from one tree to another even in the cold weather.

NESTING: April–June. Normal fosterers: Babblers.

167. **Cacomantis merulinus** (Scopoli). Plaintive Cuckoo

STATUS AND HABITAT: This is another species of uncertain status. Its calls are heard mostly in the rains in the State. It is also a forest species in the main.

GENERAL HABITS AND VOICE: It is however small and unobtrusive even when calling and again it is just possible that one fails to see it in the rest of the year, but I feel that it is unlikely that, for the last 15 years when I have been particularly looking for cuckoo species in the cold weather, I should never have even had a suspicion of seeing one.

168. **Clamator jacobinus** (Boddaert). Pied Crested Cuckoo

STATUS AND HABITAT: This is a very clearly marked migrant species and one where there is no room for any doubt as it is so easily seen and heard and keeps to open country. The birds arrive in the last week of June and are not seen beyond the end of September except, presumably, young birds which leave by the end of October.

GENERAL HABITS AND VOICE: A bird of open country, particularly open scrub forest, in the drier western parts of the State.

NESTING: July–August. Babblers are the most probable foster parents.

169. **Eudynamis scolopaceus** (Linnaeus). Indian Koel

STATUS AND HABITAT: This is another species which is of uncertain status, since it becomes silent. But I believe it to be largely resident as I have seen birds in nearly every month of the year. It may be also partially migratory. It is found all over the State.

GENERAL HABITS AND VOICE: It starts calling first of all the cuckoos and may be heard from March onwards. The breeding season of its normal fosterers, the crows, is March to May in the main in Madhya Pradesh.

170. **Rhopodytes viridirostris** (Jerdon). Small Greenbilled Malkoha

STATUS AND HABITAT: Though this species may occur in the extreme south of the State, I have no record. It is common from Hyderabad to the South of India.

171. **Taccocua leschenaultii** Lesson. Southern Sirkeer Cuckoo

STATUS AND HABITAT: This bird is widely distributed in nearly all parts of the State. It is resident and found in forest areas usually in rather grassy open forest.

GENERAL HABITS AND VOICE: Perhaps the most silent and unobtrusive bird in our list. Except when frightened up out of the grass when it runs up into a tree with hops and a few flutters of wings it is not seen or heard. Once I saw a pair courting early in June and making a few sounds.

NESTING: Presumably June–August.

172. **Centropus sinensis** (Stephens). Crow-Pheasant or Coucal

STATUS AND HABITAT: One of the resident and common birds all over the State in nearly all types of country.

NESTING: Rains, July–September.

173. **Centropus benghalensis** (Gmelin). Lesser Coucal

Is recorded in Orissa but has not been recorded by me inside the borders of this State.

174. **Psittacula eupatria** (Linnaeus). Large Indian Parakeet

STATUS AND HABITAT: Resident and widely distributed, but perhaps more a forest species than the next.

NESTING: December–February is main season.

175. **Psittacula krameri** (Scopoli). Green Parakeet

STATUS AND HABITAT: Probably the commonest species and widespread throughout the State in all types of country.

NESTING: January to April.

176. **Psittacula cyanocephala** (Linnaeus). Blossomheaded Parakeet

STATUS AND HABITAT: Resident and very numerous all over the State.

NESTING: January–April.

177. **Ketupa zeylonensis** (Gmelin). Brown Fish Owl

STATUS AND HABITAT: I have seen this species comparatively frequently and also heard its calls. It is presumably resident.

178. **Bubo bengalensis** (Franklin). Rock Eagle Owl

STATUS AND HABITAT: This species is common and widely distributed.

179. **Bubo coromandus** (Latham). Dusky Eagle Owl

This species could well occur in Madhya Pradesh but I have no notes of seeing or hearing it. It is recorded from all over India including Raipur.

180. **Otus bakkamoena** Pennant. Collared Scops Owl

STATUS AND HABITAT: This species certainly occurs, but there are no certain sight records in my notes. The call is distinctive and is heard not infrequently.

181. **Otus sunia** (Hodgson). Indian Scops Owl

GENERAL HABITS AND VOICE: *Wuck-chug-chug*! For these species of small owls identification even with good field glasses is difficult and in the absence of killed specimens I am not able to state for certain whether this bird occurs.

182. **Athene brama** (Temminck). Spotted Owlet

STATUS AND HABITAT: Common and resident all over the State and one of the most regularly distributed birds.
NESTING: Cold weather.

183. **Glaucidium radiatum** (Tickell). Jungle Owlet

STATUS AND HABITAT: Occurs and is seen not infrequently in the forest as it is on the move in the early evening.

184. **Ninox scutulata** (Raffles). Indian Hawk-Owl

STATUS AND HABITAT: This bird has been recorded from the State but I have no notes. I only read about it late in my service and was not on the look-out for it, but its call described in Sálim Ali's Birds of Travancore and Cochin appears similar to an unidentified call heard by me on several occasions.

185. **Sarcogyps calvus** (Scopoli). King or Black Vulture

STATUS AND HABITAT: Resident, and widespread in all the State.

186. **Gyps indicus indicus** (Scopoli). Longbilled Vulture

STATUS AND HABITAT: Resident and widespread in all the State. (*Gyps fulvus* may also occur as its range is to the Deccan.)
NESTING: Cold season.

187. **Pseudogyps benghalensis** (Gmelin). Whitebacked Vulture

STATUS AND HABITAT: Resident and common in all the State.
NESTING: Cold season.

188. **Neophron percnopterus** (Linnaeus). Neophron

STATUS AND HABITAT: Resident and common in all parts of the State.

189. **Aquila rapax** (Temminck). Tawny Eagle

STATUS AND HABITAT: Fairly evenly distributed all over the State. Usually seen in open country. Resident in the main.

190. **Aquila nipalensis nipalensis** Hodgson. Steppe Eagle

STATUS AND HABITAT: Recorded as a winter visitor as far east as Seoni and Raipur. I have not identified it myself and have no record.

191. **Spizaëtus cirrhatus** (Gmelin). Crested Hawk-Eagle

STATUS AND HABITAT: This is one of the most typical forest birds of the State and may be seen in nearly all places. Resident.

GENERAL HABITS AND VOICE: It strikes down peafowl and junglefowl, but I have never seen this interesting sight. A noisy species. Very considerable differences are seen in the coloration.

NESTING: Cold weather.

192. **Hieraëtus fasciatus fasciatus** (Vieillot). Bonelli's Eagle

STATUS AND HABITAT: This species may well occur in the State but I have no record of it. It is apparently similar in shape to the preceding species but has no crest. As the crest of the Crested Hawk-Eagle is not easy to see without binoculars, it may be easy to confuse the two species.

193. **Ictinaëtus malayensis** (Temm. and Laug.). Black Eagle

STATUS AND HABITAT: This species is recorded from this State but I have no notes. I only learnt about it recently and so was never on the look-out for it.

194. **Circaëtus gallicus** (Gmelin). Short-toed Eagle

STATUS AND HABITAT: I have seen this fine bird in several parts of the State but it is not common or evenly distributed. A pair can usually be seen between Chikalda and Bairat in the Melghat. I have also seen it at Kukroo in Betul: and once at Sanna in Jashpur, the other end of the Satpuras.

GENERAL HABITS AND VOICE: To my mind one of the greatest masters of flight in the bird kingdom. It makes use of upward currents of air. The kestrel has to use its wings to hover, but you can watch a Short-toed Eagle gradually shifting until he finds the exact position where he is supported like a tight-rope walker. It can then plunge to the ground like a plummet and alight so softly it would not stir a straw. It is the poetry of flight.

195. **Haematornis cheela** (Latham). Crested Serpent Eagle

STATUS AND HABITAT: Resident and widely distributed in all the forest areas of the State.

GENERAL HABITS AND VOICE: This species is found mostly along water courses and damp places in the forest. It feeds on frogs, reptiles and lizards. Often soars at considerable heights.

NESTING: March–May.

196. **Butastur teesa** (Franklin). White-eyed Buzzard

STATUS AND HABITAT: This is probably the commonest hawk of the State, being found both in open country and in open spaces in the forest. Resident and common all over.

GENERAL HABITS AND VOICE: Though most often seen sitting on a tree the bird must hunt fairly assiduously. I have seen it once with a young hare, but it must feed largely on insects and small animals.

NESTING: March–May.

197. **Haliaëtus leucoryphus** (Pallas). Pallas's Fishing Eagle

STATUS AND HABITAT: This and the next species occur in the State but I am unable to say with certainty what is their position. They are seen on the larger tanks and on deep pools on rivers even in the forest.

198. **Ichthyophaga ichthyaëtus** (Horsf.). Greyheaded Fishing Eagle

STATUS AND HABITAT: As for the last species.

199. **Haliastur indus** (Boddaert). Brahminy Kite

STATUS AND HABITAT: Resident and well distributed throughout the State wherever there are small tanks or even moderate sized pools in jungle nalas.

NESTING: January–March.

200. **Milvus migrans** (Boddaert). Common Pariah Kite

STATUS AND HABITAT: Resident and abundant all over the State.

GENERAL HABITS AND VOICE: Presumably the birds seen in the forest are less scavengers than the town bird, but I do not know what they feed on exactly.

NESTING: January–March.

201. **Elanus caeruleus vociferus** (Latham). Blackwinged Kite

STATUS AND HABITAT: A locally distributed bird seen in couples here and there in the State, usually in forest areas. Resident presumably.

GENERAL HABITS AND VOICE: Usually seen gliding and soaring by a forest hill-side, but I have little idea how it feeds or on what.

202. **Circus aeruginosus** (Linnaeus). Marsh Harrier

STATUS AND HABITAT: A winter visitor seen in well watered parts of the State. It is moderately common but numbers vary from year to year.

203. **Circus macrourus** (S. G. Gmelin). Pale Harrier

STATUS AND HABITAT: A common winter visitor and one of the characteristic sights of the open country from November to February each year. Seen all over the State and even enters open spaces in the forest.

204. **Circus pygargus** Linnaeus. Montagu's Harrier

This species probably occurs but I have no certain record.

205. **Astur badius** (Gmelin). Shikra

STATUS AND HABITAT : Resident and moderately common in the forest areas of the State.

GENERAL HABITS AND VOICE : Particularly feeds on small birds in the forest.

NESTING : Probably January–April.

206. **Accipiter nisus** (Linnaeus). Asiatic Sparrow Hawk

STATUS AND HABITAT : This is a winter visitor, but owing to its similarity to the Shikra one is uncertain of its correct status. If carefully looked for may be found to be common.

207. **Pernis ptilorhynchus** (Temm. and Schleg). Crested Honey Buzzard

STATUS AND HABITAT : This bird is not uncommon in many parts of the State both in the open and the forest. I have seen it only flying or circling and have little knowledge of its habits or status in the State.

208. **Falco peregrinus calidus** Latham. Eastern Peregrine Falcon

STATUS AND HABITAT : This falcon may occur in winter but I have no certain record. Once finding duck most unwilling to take to the air from a tank, the explanation was provided a few minutes later by a small flock of teal coming in to land at top speed with a large falcon (possibly this or the next species) chasing them in, but it did not take one and was apparently only in fun!

D'Abreu records it as taken on the banks of the Narmada.

209. **Falco peregrinus peregrinator** Sundevall. Shahin Falcon

STATUS AND HABITAT : As for the last species.

D'Abreu records it as resident and a regular breeding bird.

210. **Falco jugger** J. F. Gray. Lugger Falcon

STATUS AND HABITAT : The Lugger Falcon is seen occasionally in different parts of the State and is presumably resident.

NESTING : Probably March–April.

211. **Falco chicquera** Daudin. Turumtee or Redheaded Merlin

STATUS AND HABITAT : This is a commoner falcon than the Lugger and appears to be fairly common in hill forest areas. Presumably mainly resident.

212. **Cerchneis tinnunculus** (Linnaeus). Kestrel

STATUS AND HABITAT : This species is a winter visitor to all parts of the State and I doubt if any birds breed here.

*Note* : Both the European, as a winter visitor, and a local race, which is resident, may occur.

213. **Crocopus phoenicopterus** (Latham). Common Green Pigeon

STATUS AND HABITAT : Resident and common all over the State.

*Note* : Osmaston states he saw and heard the Kokla or Wedgetailed Green Pigeon (*Sphenocercus sphenurus*) at Pachmarhi. This species breeds in Kashmir, Kumaon and Garhwal hills and east to Assam, but migrates to the plains in winter. It has not been recorded by anyone else in central India.

NESTING: February–April.

214. **Muscadivora aenea** (Linnaeus). Green Imperial Pigeon

STATUS AND HABITAT: Very locally distributed in the south of the State. There used to be a colony at Junona F. V. near Chanda town.

215. **Chalcophaps indica** (Linnaeus). Indian Emerald Dove

STATUS AND HABITAT: A very patchily distributed species and resident where found. They are common in the Kangar Reserve, Bastar, and occasional in other parts of Bastar. There is also a colony in Balaghat, Mandla. Some specimens in the Nagpur Museum were obtained in Balaghat, and Mr. C. E. C. Cox told me of this colony. I saw one bird myself in the Kanha Game Reserve in May 1955. Otherwise this species does not occur in any other locality in Madhya Pradesh to the best of my knowledge.

216. **Columba livia** Gmelin. Blue Rock Pigeon

STATUS AND HABITAT: Resident and common throughout the State.

GENERAL HABITS AND VOICE: The birds may be divided into two classes; those that live in various works of man such as buildings, wells, bridges; and the true jungle birds which nest in rocky caves etc. Both fly considerable distances from their base to feeding grounds.

NESTING: Probably all the year.

217. **Streptopelia orientalis** (Latham). Rufous Turtle Dove

STATUS AND HABITAT: Found in the better quality forest and hill ranges. It is more of a forest species than the other doves. Local and not seen in many areas.

GENERAL HABITS AND VOICE: This dove is found in small parties mostly inside the forest, but when crops are being reaped it may be found in larger numbers out in the fields.

NESTING: Probably February–March, mostly.

218. **Streptopelia chinensis** (Scopoli). Spotted Dove

STATUS AND HABITAT: This is the commonest dove of the State and is also one of the birds which seem equally at home in the forest. This is to be noted as the general belief is that it is a bird of open country.

NESTING: All the year except the rains.

219. **Streptopelia senegalensis** (Linnaeus). Little Brown Dove

STATUS AND HABITAT: A bird of open country and gardens and not a forest species. Not so common as the last species and much less hardy.

GENERAL HABITS AND VOICE: The most quiet and 'gentlest' dove.

NESTING: All the year except the rains.

220. **Streptopelia decaocto** (Frivalszky). Indian Ring Dove

STATUS AND HABITAT: Common and widely distributed in all parts of the State. Presumably resident, but numbers seem to vary.

A bird of the open country in particular, and not generally seen in the forest.

NESTING: All the year.

221. **Oenopopelia tranquebarica** (Hermann). Red Turtle Dove

STATUS AND HABITAT: A widely distributed but patchy bird all over the State, particularly in open country. Numbers vary markedly and males seem often to be absent entirely in the cold weather, or scarce. Whistler, page 401, mentions that large flocks consisting entirely of males are sometimes found, so that this suggests a seasonal movement at least of males.

222. **Pterocles exustus** Temminck. Common Sandgrouse

STATUS AND HABITAT: Not particularly common or widespread.

In small parties in the more open and drier areas to the west of the State.

223. **Pterocles indicus** (Gmelin). Painted Sandgrouse

STATUS AND HABITAT: This is the most typical sandgrouse of this tract. It is found in nearly all forests. From December to May or June they are found in pairs on firelines or forest roads. Towards the end of the rains they collect in considerable numbers in favourite localities in open raised country particularly where the ground is covered with 'Wild Indigo' (*Tephrosia purpurea*). The birds rise when shot at and tend to break up into small coveys which may be true family parties. The birds drink at dusk at jungle pools and pairs may be seen coming to drink from all directions.

NESTING: January–April.

224. **Pavo cristatus** Linnaeus. Common Peafowl

STATUS AND HABITAT: Common and resident all over the State in all forests and scrub. Though not considered sacred, they do not have many human enemies and their numbers are large.

GENERAL HABITS AND VOICE: They are extremely sharp-sighted and have wonderful hearing. We were amazed at how they could pick up the slight whirr of a small 8 mm. cine camera 20–30 yards away.

NESTING: April–May mostly, with perhaps a second brood in August-September.

225. **Gallus sonneratii** Temminck. Grey Junglefowl

STATUS AND HABITAT: The resident species of the west of the State more or less up to the sal forests. It is not evenly distributed and may be absent over considerable areas. At places it may be common. Teak and bamboo forest are usual haunts, and it is common in the lantana-infested Melghat.

NESTING: March–June. There may be second broods in September–October just after the rains.

226. **Gallus bankiva** Temminck. Red Junglefowl

STATUS AND HABITAT: The Red Junglefowl is found in the east of the State particularly in the sal forests. It is not however rigidly confined and may be found for instance in the teak and bamboo forests adjacent to the sal forests in Mandla. Hybrids between the two species are said to occur in the zone in which they overlap. The small colony which used to live in the sal forests round Pachmarhi in Forsyth's day seems to have gone. I could not find any.

NESTING: March–May.

227. **Galloperdix spadicea** (Gmelin). Red Spurfowl

STATUS AND HABITAT: A common species in the dry deciduous forests of the entire State except perhaps the extreme east. Resident.

GENERAL HABITS AND VOICE: Though found in pairs scattered in the forest, it is a hardy species and often the only sign of life in some forests which have been cleared of game.

NESTING: March–June.

228. **Galloperdix lunulata** (Valenciennes). Painted Spurfowl

STATUS AND HABITAT: This smart little bird appears to be more common in the extreme east of the State, and in Surguja it appears to take the place of the Red Spurfowl. I have once seen it in Balaghat also, but have too little knowledge of these parts of the State to fix the western boundary accurately. Its distribution is not the same as *G. spadicea.*

229. **Coturnix coturnix** (Linnaeus). Common Quail

STATUS AND HABITAT: Resident, but many migrants come in winter too. Widely distributed all over the State, usually in pairs in open country.

NESTING: March–May.

230. **Coturnix coromandelicus** (Gmelin). Rain Quail

STATUS AND HABITAT: Resident and also migratory, but I have little definite information as this can only be obtained from marked birds.

NESTING: Rains.

231. **Excalfactoria chinensis** (Linnaeus). Bluebreasted Quail

Though this bird might occur in Madhya Pradesh I have no record. It is a peculiarly patchily distributed bird and few specimens have been recorded for many years.

232. **Perdicula asiatica** (Latham). Jungle Bush-Quail

STATUS AND HABITAT: A common species in all forests, and at times almost abundant. It is found all over the State in all months of the year, but probably there are movements as at times they seem very numerous.

NESTING: No records but young birds are seen in nearly every month.

233. **Perdicula argoondah** (Sykes). Rock Bush-Quail

STATUS AND HABITAT: This species almost certainly occurs in the State, but I have not managed to identify it separately in the field from the preceding species. The Jungle Bush-Quail inhabits forest and light scrub while the Rock Bush-Quail is found in dry open, sandy or rocky plains.

234. **Cryptoplectron erythrorhynchum** (Sykes). Painted Bush-Quail

STATUS AND HABITAT: A separate race, *blewitti*, occurs in east Madhya Pradesh, but I have not recorded it as I was not aware of its existence early enough to look for it and as with most quails one does not often get a chance to pick out small differences in the field.

235. **Francolinus francolinus** (Linnaeus). Black Partridge

STATUS AND HABITAT : This partridge may occur in the north of the State, but I have no records. I have spent very little time in Sagar district where it is most likely to occur. (*Note*: Moss King, in 1911, said he had not seen the bird in Sagar, but notes one was shot in 1909.)

236. **Francolinus pictus** (Jardine & Selby). Painted Partridge

STATUS AND HABITAT : This is a widely distributed species in the State, but occurs in small pockets; I associate it particularly with grassy maidans inside the forest. This may be because birds in more open country get netted.

GENERAL HABITS AND VOICE : Lives in grassy country. The call is distinctive. It often calls from trees, but it is almost impossible to pin down exactly where the bird is calling from.

NESTING : Rains.

237. **Francolinus pondicerianus** (Gmelin). Grey Partridge

STATUS AND HABITAT : This is the most common partridge all over the State and very hardy and capable of living under all conditions. It is met most often in the open country right up to habitation, but is also seen inside the forest.

GENERAL HABITS AND VOICE : A ground feeder and good runner, and strong on the wing.

NESTING : Mostly March–May, but probably also in the cold weather.

[**Turnix suscitator** (Gmelin). Common Bustard-Quail
**Turnix sylvatica** (Desfontaines). Little Button-Quail
**Turnix maculatus tanki** Blyth. Indian Button-Quail

STATUS AND HABITAT : The three species are all likely to occur in the State but I have no records. This is due to bad observing rather than their scarcity.]

238. **Amaurornis phoenicurus** (Pennant). Whitebreasted Waterhen

STATUS AND HABITAT : Widespread all over the State and resident. I associate it particularly with the pools in nalas in the forest where dense bushes and climbers come down to the water's edge. These provide the ideal conditions. Also found round water all over, even in the open.

NESTING : Rains.

239. **Gallinula chloropus indicus** Blyth. Waterhen or Indian Moorhen

STATUS AND HABITAT : Widely distributed in all parts of the State where there are tanks and plenty of water.

NESTING : Rains.

240. **Fulica atra** Linnaeus. Common Coot

241. **Porphyrio poliocephalus** (Latham). Purple Moorhen

STATUS AND HABITAT : Common on tanks in all the well-watered parts of the State. Resident in the main; the numbers certainly seem larger in the winter, but the extent of such migrations is difficult to gauge. The Purple Moorhen almost certainly occurs but I have failed to recognise it as a separate individual.

NESTING: Rains.

242. **Grus grus** (Linnaeus). Common Crane

STATUS AND HABITAT: Winter visitor, found sparingly along the larger rivers. The numbers vary greatly from year to year. Narmada and Mahanadi rivers in the north and south-west are localities where they may be found.

243. **Anthropoides virgo** (Linnaeus). Demoiselle Crane

STATUS AND HABITAT: This species occurs in much the same way as the preceding, but is probably commoner.

244. **Antigone antigone** (Linnaeus). Sarus Crane

STATUS AND HABITAT: The Sarus occurs patchily in different parts of the State. It is fairly common in the well-watered parts of the rice growing districts Bhandara, Balaghat and Raipur, and in Jabalpur. In Hoshangabad they are found along the Narmada in the open season but these birds move off in the rains. Resident.

NESTING: Rains.

245. **Sypheotides indica** (Miller). Likh Floriken

STATUS AND HABITAT: Never recorded by me, but I have heard of birds being shot in Nimar, the most western district. This is probably the extreme limit of the bird in the State.

246. **Choriotis nigriceps** (Vigors). Great Indian Bustard

Did occur in the State, but I never saw one and it may no longer exist.

247. **Burhinus oedicnemus** (Linnaeus). Stone Curlew

STATUS AND HABITAT: This is found all over the State and is resident. I have seen it most in the openly stocked patches within the denser mixed forest in the Government Reserves. It is a bird of scrub growth.

GENERAL HABITS AND VOICE: Though seen by day by those whose work takes them in the forest, it is a species whose calls after dusk are most familiar, though many people are ignorantof the vocalist.

NESTING: Probably March–June. Moss King found eggs as late as August in Sagar.

248. **Esacus recurvirostris** (Cuvier). Great Stone Plover

STATUS AND HABITAT: This bird has been seen by me only on the Narmada River near Hoshangabad. Resident where found.

GENERAL HABITS AND VOICE: It is found on the islands in the river. It has a curious call like the whine or sqeak of an unoiled gate.

NESTING: Nests from March to May in Sagar (M. K.)

249. **Cursorius coromandelicus** (Gmelin). Indian Courser

STATUS AND HABITAT: A locally distributed bird in the drier open country. Probably also partly migratory. A typical habitat is the open country round Multai in Betul District.

GENERAL HABITS AND VOICE: A bird of fallow fields, village wastes etc. I have not noted any call. When on the move it flies high and strongly.

NESTING: March–rains (probably).

250. **Glareola lactea** Temminck. Little Indian Pratincole

STATUS AND HABITAT: A locally distributed bird. I have found it common only on the Narmada River near Hoshangabad. I also once saw a flock on the landing ground of Jagdalpur; probably from the Indravati River which is close by.

GENERAL HABITS AND VOICE: At Hoshangabad the colony lived on the sandy islands in the river bed during the open season, but when the river bed was covered in the rains, they moved. I saw them only when flying overhead in the evenings, hawking insects in company with swifts.

NESTING: March–May.

251. **Glareola maldivarum** Forster. Large Indian Pratincole

STATUS AND HABITAT: I have only one record of this species. A small colony was found in the dry bed of the Ghorawala Reservoir near Nagpur in a year when the water level was very low.

D'Abreu notes it as resident and breeding in May.

252. **Metopidius indicus** (Latham). Bronzewinged Jaçana

STATUS AND HABITAT: A common species on smaller or shallower tanks where there is plenty of weed growth. Resident.

NESTING: Rains.

253. **Hydrophasianus chirurgus** (Scopoli). Pheasant-tailed Jaçana

STATUS AND HABITAT: Similar to the last, but probably commoner and bolder species and more tolerant of man.

NESTING: Rains.

254. **Lobivanellus indicus** (Boddaert). Redwattled Lapwing

STATUS AND HABITAT: One of the common and most widely distributed birds of the State, being found in nearly all types of country; inside the forest, in open fields and along bare river beds.

NESTING: June—August.

255. **Lobipluvia malabarica** (Boddaert). Yellow-wattled Lapwing

STATUS AND HABITAT: A great deal less common and less widely distributed than the last. It is a bird of the more open bare land having somewhat the same demands as the Indian Courser.

GENERAL HABITS AND VOICE: Presumably feeds on small insects. The call is much less vigorous and challenging than that of the Redwattled.

NESTING: May–June.

256. **Hoplopterus duvaucelii** (Lesson). Spurwinged Plover

STATUS AND HABITAT: This bird is common on nearly all the larger rivers and their tributaries wherever there are fairly continuous stretches of water in most parts of the State. It is not confined to the large rivers.

GENERAL HABITS AND VOICE: Feeds along the edges of river beds and nalas. It is very noisy and calls repeatedly at intruders both human and animal, but this it appears to do on principle rather than through fear for its nests. The call is similar in timbre and vigour to the Redwattled Lapwing's.

257. **Charadrius dubius** Scopoli. Little Ring Plover

STATUS AND HABITAT : Fairly common and resident on the sandy stretches and beds of rivers and nalas. It is found all over the State.

NESTING : March—April.

258. **Himantopus himantopus** (Linnaeus). Blackwinged Stilt

STATUS AND HABITAT : Seen occasionally in parties in small tanks, round larger tanks, and in pools in nalas. More or less resident and unevenly distributed all over the State.

259. **Numenius arquata** (Linnaeus). Curlew

STATUS AND HABITAT : A rare winter visitor to large tanks or river beds. My only records are of a few birds on the Narmada River at Hoshangabad.

260. **Tringa hypoleucos** Linnaeus. Common Sandpiper

STATUS AND HABITAT : A migrant species but absent only from May to June. Found all over the State wherever there are even small patches of water.

261. **Tringa ochrophus** Linnaeus. Green Sandpiper

261A. **Tringa glareola** Linnaeus. Wood Sandpiper

STATUS AND HABITAT : Also a migrant species and found during the cold weather in all parts. *T. glareola* is also found scattered in small parties.

GENERAL HABITS AND VOICE : This is a more solitary bird than the others in its winter haunts.

262. **Tringa nebularia** (Gunnerus). Greenshank

STATUS AND HABITAT : Similar status to the preceding species, but less common. It is usually solitary and a single individual may be seen where other species are present in tens or twenties.

[**Tringa totanus** (Linnaeus). Redshank

STATUS AND HABITAT : This species should occur, but I have no record of it myself.]

263. **Erolia minuta** (Leisler). Little Stint

263A. **Erolia temminckii** (Leisler). Temminck's Stint

STATUS AND HABITAT : An occasional winter visitor in parties to larger rivers and lakes. They are not seen regularly, and only for a short time. These are probably parties which wander about a good deal in the cold weather and do not take up permanent winter quarters. I am not sure whether both species occur or which is the common one.

264. **Capella gallinago** (Linnaeus). Common Snipe

STATUS AND HABITAT: This species is widespread in moist ground from September to April, but most birds are seen from November to January. After January suitable moist land becomes scarce.

265. **Capella nemoricola** (Hodgson)? The Wood Snipe may be found on migration. D'Abreu records it from Mandla, Surguja and Amarkantak.

266. **Capella stenura** (Bonaparte). Pintail Snipe

267. **Lymnocryptes minima** (Brunnich). Jack Snipe

STATUS AND HABITAT: As for the previous species, but in the east of the State only. The Jack Snipe is found occasionally in the same type of habitat in small numbers, all over the State.

268. **Rostratula benghalensis** (Linnaeus). Painted Snipe

STATUS AND HABITAT: A widely distributed but occasional resident species. Found in wet ground below tanks where there are bushes and tufts of grass,

269. **Chlidonias leucopareia** (Temminck). Whiskered Tern

STATUS AND HABITAT: A resident species in most of the State. It is seen fairly regularly all over the well-watered parts, whether lakes or large rivers.

GENERAL HABITS AND VOICE: One of the most graceful fliers in the bird kingdom.

NESTING: March—April on sand banks in rivers. All the terns breed on islands in rivers which are often covered by small floods if there is unseasonable rain in March or April, but these two months to which breeding is confined are the safest in the year.

270. **Sterna aurantia** Gray. Common River Tern

STATUS AND HABITAT: This is probably more common and more frequently seen than the last species.

NESTING: March–April.

271. **Sterna melanogaster** Temminck. Blackbellied Tern

STATUS AND HABITAT: I have noted this species particularly on the Narmada where it is resident and fairly common.

GENERAL HABITS AND VOICE: Similar to other terns.

NESTING: March–April.

272. **Sterna albifrons** Vroeg. Little Tern

STATUS AND HABITAT: This is a small edition of the other terns and I have recorded it only from the Narmada.

GENERAL HABITS AND VOICE: Similar to other species of tern.

NESTING: March–April.

273. **Rhynchops albicollis** Swainson. Indian Skimmer

STATUS AND HABITAT: I have seen this remarkable bird only on the Narmada. There were a few individuals always in the hot weather near Hoshangabad, and they were breeding on the same islands with other terns etc.

GENERAL HABITS AND VOICE: I have watched the remarkable actions of this bird at close range. They adjust their height carefully, and having found a still piece of water they plough along with their beaks. To my disappointment I never saw any evidence of their catching anything.

NESTING: March–April.

274. **Pelecanus onocrotalus roseus** Gmelin. Spottedbilled Pelican

STATUS AND HABITAT: The bird is seen occasionally here and there in the State usually as a single bird.

275. **Phalacrocorax niger** (Vieillot). Little Cormorant

STATUS AND HABITAT: A common and very numerous species in all watered parts of the State. They are particularly seen on large pools in the forest nalas. Resident.

GENERAL HABITS AND VOICE: Fishes in large flocks together.

NESTING: Rains.

276. **Phalacrocorax carbo** (Linnaeus). Large Cormorant

STATUS AND HABITAT: Occasionally seen in the same sort of habitat as the preceding species.

GENERAL HABITS AND VOICE: As for the smaller bird.

277. **Anhinga melanogaster** Pennant. Indian Darter

STATUS AND HABITAT: Seen fairly regularly in ones or pairs in tanks and also on pools in the jungle. Resident. A very characteristic and well distributed member of the bird population in the State.

278. **Threskiornis melanocephalus** (Latham). White Ibis

STATUS AND HABITAT: Not a common bird, but seen here and there in the well-watered parts of the State. Resident.

NESTING: Rains.

279. **Pseudibis papillosa** (Temminck). Black Ibis

STATUS AND HABITAT: A much more common and more widely distributed species than the last. It is found in a wider variety of habitats and even in quite dry places.

GENERAL HABITS AND VOICE: I once saw a bird feeding on a sand bank in the Narmada and being robbed by a drongo as soon as he dug up a worm or something edible.

NESTING: No notes for certain but probably rains to early cold weather.

280. **Platalea leucorodia** Linnaeus. Spoonbill

STATUS AND HABITAT: I have recorded this species only in the north of the State, where occasional individuals are found along the deeper pools left in the bed of the Narmada River.

281. **Dissoura episcopus** (Boddaert). Whitenecked Stork

STATUS AND HABITAT: A widely distributed species found nearly all over the State and able to exist with little water. It is often found hunting round the last small pools as the water dries up. Resident.

282. **Xenorhynchus asiaticus** (Latham). Blacknecked Stork

STATUS AND HABITAT: Occasional individuals seen in large rivers. It is not common or widespread. The White Stork (*Ciconia ciconia*) has never been recorded by me in Madhya Pradesh.

283. **Ibis leucocephalus** (Pennant). Painted Stork

STATUS AND HABITAT: This stork is comparatively common and resident in all the well-watered parts of the State, and is characteristic.

NESTING: Cold weather to February. I remember a big colony breeding on Imli (*Tamarindus indicus*) trees in a village in the east of Chanda district in February.

[In May 1955 I saw two smaller Adjutant Storks (*Leptoptilos javanicus*) in Kanha National Park. This is the only record I have of either of the Adjutant Storks.]

284. **Anastomus oscitans** (Boddaert). Openbill

STATUS AND HABITAT: This is by a long way the most common stork in the State and may be found wherever there are tanks and large rivers. Resident.

NESTING: Rains.

285. **Ardea cinerea** Linnaeus. Common Heron

286. **Ardea purpurea manillensis** Meyer. Purple Heron

STATUS AND HABITAT: Well distributed and comparatively common all over the State. Resident.

The Purple Heron is seen occasionally all over the State.

It has much the same habits as the Grey, but is much more crepuscular and feeds chiefly in the mornings and evenings.

NESTING: Rains.

287. **Egretta garzetta** (Linnaeus). Little Egret

STATUS AND HABITAT: A moderately common and well distributed resident species.

NESTING: Rains.

288. **Egretta alba modesta** (Gray). Large Egret

STATUS AND HABITAT: Occasionally seen but not a common bird. Usually solitary individuals. Resident.

289. **Egretta intermedia intermedia** (Wagler). Smaller Egret

STATUS AND HABITAT: This is a commoner bird than the last and found in all well-watered parts of the State. Resident.

290. **Bubulcus ibis** (Linnaeus). Cattle Egret

STATUS AND HABITAT: The commonest of all these birds and found all over the State. It is a more adaptable species and has a more varied diet. Resident. It occurs in quite large flocks.

GENERAL HABITS AND VOICE: They attend grazing cattle particularly in the rains and cold weather. The nuptial plumes are assumed from March–April.

NESTING: Rains.

291. **Ardeola grayii** (Sykes). Paddy Bird

STATUS AND HABITAT : A solitary but abundant bird all over the State being able to sustain itself at the smallest borrow pit of water. Resident.

NESTING : Rains.

[**Nycticorax nycticorax** (Linnaeus). Night Heron

STATUS AND HABITAT : Not recorded by me but should occur in the State.]

292. **Butorides striatus** (Linnaeus). Little Green Bittern

STATUS AND HABITAT : This is quite a common species in many nalas in the forest. Where the bushes and shrubs come down to the water level and form thickets, this little heron is quite characteristic.

GENERAL HABITS AND VOICE : A shy bird seen with difficulty. No record of the voice. I have not recorded any other bitterns, but they might well occur.

[**Ixobrychus cinnamomeus** (Gmelin). Chestnut Bittern

This species will probably be found though not recorded by me. They live in reeds and round tanks.]

293. **Phoenicopterus ruber** Linnaeus. Large Flamingo

STATUS AND HABITAT : Stragglers may be found in any part of the State. I saw one bird on the Narmada near Hoshangabad. They have been recorded at the salt lake at Loni in Buldana district. They have also been recorded at Nagpur.

294. **Sarkidiornis melanotos** (Pennant). Nukta

STATUS AND HABITAT : Seen here and there in small flocks in the well-watered parts of the State. Resident in the main.

295. **Nettapus coromandelianus** (Gmelin). Cotton Teal

STATUS AND HABITAT : A common bird being found on nearly every tank however small, though never in large numbers. Resident.

GENERAL HABITS AND VOICE : It is very loath to leave its tank even when fired on repeatedly. When the other ducks have all gone it still flies round and soon settles.

NESTING : Rains.

296. **Anser indicus** (Latham). Barheaded Goose

STATUS AND HABITAT : A winter visitor to parts of the State mainly along the big rivers in the north, but also occasionally in the south along the Mahanadi in Chhattisgarh. Birds are seen from December to February being most common in January.

GENERAL HABITS AND VOICE : They feed in the young wheat and gram fields up to 07·30–08·00 hours in the cold weather when the villagers come out for the day's work. The feeding flocks can be approached quite closely on a horse.

297. **Dendrocygna javanica** (Horsfield). Whistling Teal

STATUS AND HABITAT : The most abundant and well distributed duck in the State. Medium to large flocks are found on many tanks, even small tanks in the forest. Resident. I have not recorded the Larger Whistling Teal (*D. fulva*) in Madhya Pradesh. It has been recorded from the Deccan, but East Bengal is the main habitat.

GENERAL HABITS AND VOICE : The bird flights regularly in the evenings. I have not recorded it roosting in the trees.

NESTING : Rains.

298. **Casarca ferruginea** (Vroeg). Ruddy Sheldrake

STATUS AND HABITAT : A winter visitor common in many parts of the State on all the larger rivers and nalas. It may be said to be quite common.

299. **Anas poecilorhyncha** Forster. Spotbill

STATUS AND HABITAT : Found locally in a few places in the State. My records are all from Bhandara district. A resident duck. It is the sort of bird which might disappear altogether without anyone being sure just when the last duck was seen.

NESTING : Rains.

300. **Chaulelasmus streperus** (Linnaeus). Gadwall

STATUS AND HABITAT : One of the regular winter migrants to all parts of the State. Present from December to March.

301. **Nettion crecca** (Linnaeus). Common Teal

STATUS AND HABITAT : A migrant species from October to even May, but the main body visits this State from December–March. It is, however, one of the last migrants to leave.

302. **Querquedula querquedula** (Linnaeus). Garganey Teal

STATUS AND HABITAT : Much the same as the preceding species; perhaps the Common Teal is slightly more numerous.

303. **Dafila acuta** (Linnaeus). Pintail

STATUS AND HABITAT : This is one of the main migrant species to this State and the finest eating bird. It is found in most years fairly evenly distributed all over the State.

304. **Spatula clypeata** (Linnaeus). Shoveller

STATUS AND HABITAT : A winter migrant species found in scattered pairs or small parties here and there in the well-watered parts of the State.

305. **Nyroca ferina** (Linnaeus). Pochard

STATUS AND HABITAT : A regular winter visitor and one of the ducks represented on many large tanks where ducks collect, but never very numerous.

306. **Netta rufina** (Pallas). Redcrested Pochard

STATUS AND HABITAT : Similar to the preceding species but less frequent.

307. **Nyroca rufa** (Linnaeus). White-eye

STATUS AND HABITAT : This duck is one of the more common and widespread migrant ducks, and found all over the State wherever there are tanks.

308. **Podiceps ruficollis** (Vroeg). Little Grebe

STATUS AND HABITAT : One of the most widespread and constant species on all water. Resident. It can move about when tanks dry up. At Amravati, the Wadali tanks were completely dry at the end of the 1953 hot weather, but within a week of filling, the grebes had arrived.

NESTING : Rains.

# GAME PRESERVATION IN JAMMU AND KASHMIR STATE

BY

COL. K. GUMAN SINGH, I.A.

I am sure all those who are interested in game preservation were happy to read the report of the Society's delegation on 'Game Preservation in Kashmir', published in Volume 53 (2) of the *Journal* —December 1955. There are some excellent recommendations made in this report and, if only the Government of Jammu and Kashmir State could adopt them with speed, much could be achieved towards game preservation in that State.

Besides what has already been suggested I have the following additional suggestions to offer.

## GAME STAFF

(*a*) If I am correct, at present there is only one Game Warden for the whole of Jammu and Kashmir State. I, therefore, strongly feel that considering the large area involved it is physically impossible for him to carry out his duties with any measure of efficiency. The Game Warden has also been burdened with other responsibilities connected with the Forest Department. I recommend that, in fairness to his post, the Game Warden should not be given any other duties. Three Assistant Game Wardens, one each for Jammu, Kashmir Valley and Ladakh, should be appointed together with sufficient numbers of game rangers and watchers. At present Ladakh has no game staff at all, and this state of affairs is encouraging heavy poaching. It is not possible for a Divisional Forest Officer and his normal forest staff to take keen interest in the protection of game besides attending to their other duties.

(*b*) Persons so appointed, as suggested above, should be carefully selected from among those who are keen sportsmen and naturalists. It is only these types of persons who could be expected to visit inaccessible areas and high hills in order to perform their duties efficiently.

(*c*) The game staff should be made to:

(i) Carry out surprise checks of known poachers' houses for any horns and skins. Houses of others are also to be searched which are close to a game reserve or sanctuary.

(ii) Carry out surprise checks of hotels and restaurants to see whether venison is being served.

(iii) Carry out surprise checks on roads of motor vehicles coming from the direction of a game reserve or sanctuary, in order to see whether any game shot without permit, or its meat, skin or horns, are being carried. They could also lie in wait on tracks coming from a game reserve or sanctuary in order to surprise and catch any poachers.

(iv) Carry out surprise checks of all local taxidermists' shops for illicit skins and horns. Any undersized horns are also to be looked for and seized, and the matter reported for taking action against the shikari/taxidermist concerned, as the case may be.

(*d*) In Africa a member of the game staff accompanies a hunter in order to ensure that no illegal shooting is done. I recommend that this could also be adopted with advantage in this State. A similar practice also exists in the United States of America, whereby all game shot is shown to the game staff before it is taken out from a game reserve area.

(*e*) The game staff must be suitably rewarded for catching a poacher or reporting any infringement of game laws by a shikari.

(*f*) Suitable propaganda must be done among the villages, especially near a game reserve/sanctuary, so that their inhabitants may be discouraged from illicit shooting.

## DESTRUCTION OF VERMIN

The following birds and animals at present are classed as vermin in the Game Act:

Leopard
Snow Leopard[1]
Wolf
Jackal
Fox
Otter
Lynx
Wild Cat
Pine-marten
Mongoose
Carrion Crow
Cormorant and other fish-eating birds.

To the above list the Black Bear has now been very rightly added. Rewards on the following scale are also sanctioned by the same Act:

| | |
|---|---|
| Leopard and Snow Leopard, each | Rs. 10-0-0 |
| Leopard and Snow Leopard Cubs of, each | Rs. 5-0-0 |
| Wolf, Lynx and Otter, each | Rs. 5-0-0 |
| Marten and Wild Cat, each | Rs. 2-0-0 |
| Mongoose and Carrion Crow, Cormorant and other fish killing vermin, each | Re. 0-4-0 |

The Black Bear now carries a reward of Rs. 15.

It will be seen from above that, although provision has been made in the Game Act for rewarding those who kill vermin, hardly anyone knows about it, especially in the villages. Thus no one cares to shoot them or, if one has been killed by chance, to claim a reward for it. From my personal knowledge I can say that in the majority of cases, even the license holders, are not aware of these rewards.

During my recent shikar trip to Ladakh I noticed that the Snow Leopard and Wolf had considerably increased in numbers. At many places I picked up a number of horns, attached to skulls, of Ibex (*Capra siberica*) and Shapu (*Ovis vignei*) which had been killed by them. Considering the heavy destruction that is being caused by the Snow Leopard[1] and Wolf, I would strongly recommend that their rewards be raised to Rs. 15 and Rs. 10 respectively. Suitable propaganda should also be carried out among villages to destroy vermin by whatever means they can and to claim the rewards. All those taking out arms licenses and game licenses should also be specifically told to kill vermin.

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[1] Paradoxically enough the Snow Leopard is included in the schedule of *protected* animals in Customs Notification No. 175, dated 29-10-1955 which prohibits their export from India, dead or alive or in parts (e.g., skin) except under special permit from the Secretary General, Indian Board for Wild Life !—EDS.

Some of the large varieties of eagles are also known to prey on the young of Muskdeer (*Moschus moschiferus*), Ibex and Shapu, while hawks prey on game birds, and these should be added to the list of vermin.[1]

## GAME SANCTUARIES AND RESERVES

Although there are some game sanctuaries in Jammu and the Kashmir areas, there are none in Ladakh. The two sanctuaries mentioned under Ladakh in the Game Act are under Pakistan occupation at present. New sanctuaries should be formed in Ladakh so that proper protection is given to all species of game found in this area.

The list of Game Reserves given in the Act should also be reviewed owing to the changed conditions and subsequent migration of game from one area to another, and new reserves established. In this connection I hope to give my views to the Game Department of this State shortly.

## KASHMIR WOOL (SHAHTOSHAH)

The Society's delegation mentioned in their Report that, according to the data procured by them, they feel that the fine 'Shahtoshah' wool, although partly coming from the soft undercoat of Ibex (*Capra siberica*), Tibetan Antelope (*Panthalops hodgsoni*) and Gazelle (*Gazella picticaudata*), derived mainly from the Tibetan goat. I, however, beg to differ partly in this respect. The information I collected in Ladakh from those who were actually concerned with this trade was that the finest quality of wool came solely from the Tibetan Antelope called 'Chiru'. In April, which is the best time for extracting this wool, these antelopes are mostly caught in traps laid at water-holes. I admit that the bulk of the fine wool 'Pashm', used for making shawls, is extracted from the Tibetan goat in Chanthang area, but the finest of them all, from which the 'ring shawls' are made, are mainly the product of the Tibetan Antelope. Ibex also partly supplies a small quantity of the finest wool. But as they are found at great heights and in difficult terrain, especially in April, not many are brought to bag by local poachers for this purpose.

I am not aware whether there is any license imposed by the Jammu and Kashmir Government on those who carry on this trade. As long as the traders only deal with the wool procured from the undercoat of the domestic goat, there is no danger to the game. But, if the State Government wishes to obtain the finest underwool from 'Chiru' and Ibex for trade purposes, then some sort of check must be imposed on their killing. I suggest that the Game Department of the State should depute an officer to acquire full details of this trade and then make suitable recommendations to the Government, so that the uncontrolled destruction of these game animals is stopped.

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[1] Question—EDS.

## Introduction of Foreign Game[1]

I am afraid I do not agree with the delegation's recommendation that foreign species of game should not be introduced in Kashmir, because the experience of other countries in this respect has not been encouraging. In fact from what I have read in foreign journals on game, my knowledge is to the contrary. The Red Deer, Sambar and Cheetal introduced in New Zealand have thriven well. The Chakor and the Blackbuck introduced in the United States of America have also done very well. The Chakor is now one of the prized game birds in that country. The Chinese Ringneck Pheasant has been introduced in many countries including England and America with great success. When other countries could successfully introduce game animals and birds especially from India, I do not see any reason why we should not follow suit.

In view of the above I strongly advocate the introduction of foreign game animals and birds as under:

(*a*) Wapiti (Elk deer of America). This is one of the largest of the deer species found in the World. Its record antlers measure over 60 inches and are a magnificent trophy. It is an upland deer and is found among the fir forests of America, which become snow bound during winter. The conditions, therefore, in the Kashmir Valley are ideal for its habitat. It should be introduced into those fir forests where the Barasingh is not found, so as to keep the two animals apart from interbreeding. The Pir Panjal and Kishtwar areas ought to serve the purpose. These areas will also then have more attraction for a shikari, naturalist or photographer. This deer, however, should only be introduced when it is made certain that it would not fall a prey to poachers. In the meanwhile information about its habits and characteristics could be obtained from America.

(*b*) Bobwhite Quail of America. This quail is much bigger than any of the species of quail found in this country. It is also one of the finest game birds of America and its introduction would be an asset to the State.

(*c*) Chinese Ringneck Pheasant. As mentioned before, due to its fine qualities as a game bird, it has been imported from China into many foreign countries, including England and America where it is classed as a top game bird. If I am correct, the late Maharaja of Patiala had introduced this pheasant with success at his summer resort at Chail near Simla.[2]

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[1] This is a highly controversial subject and the writer's views are not necessarily ours.—Eds.

[2] For an account of this experiment see *JBNHS.* 33 : 120-135.

The game birds mentioned above could be introduced in the State without any serious danger from poachers. Plans should, therefore, be made for importing them as soon as possible.

Finally I wish to state that the recommendations which have been made by the Society's delegation and those made by me will require more expenditure in money than what the State is now spending on game preservation. But if the State Government wishes to save its wonderful game animals and birds from total extinction, then it must be done quickly, otherwise it may become too late to do so due to the heavy poaching which is going on at present.

# NOTES ON THE HETEROCERA OF CALCUTTA

BY

D. G. SEVASTOPULO, F.R.E.S.

## PART II

*(Continued from p.* 422 *of this volume)*

The present part deals with the Agrotidae, formerly Noctuidae. I have divided the family up into its present sub-families. Hampson's divisions have now been revised in many cases and, as many of Hampson's names are no longer current, I have added the modern name.

It has occurred to me that there is one point that needs clarification in this series of papers. The records of relative abundance refer to the months of occurrence only. Thus an insect that was common in, say, April, and not recorded for the rest of the year, would be shewn as 'Common. iv.' whilst another, that occurred rarely all through the year would be shewn as 'Rare. Records for all months,' although more specimens of the latter might occur taking the year as a whole than of the former. Unless otherwise stated, all records are for light.

## AGROTIDAE

### LUXOINAE

**Agrotis biconica** Koll.—Common. Larvae feed on grass. Records for iv, vi and vii. Now *Euxoa spinifera* Hbn.

**A. ypsilon** Rott.—Common in some years, rare in others. Records for i, ii, and xii. Now *Rhyacia.*

### HADENINAE

**Polytela gloriosae** F.—Imagines rare, larvae common on Liliaceae and Amaryllidaceae. Recorded in vi, vii and viii.

**Leucania irrorata** Moore—Uncommon. Records for i, v, and xii. Now *Sideridis insularis* Btlr.

**L. irregularis** Wlk.—Common. Recorded in i, ii, iv, vi, xi and xii. Now *Sideridis.*

**L. exempta** Wlk.—Common. Records for all months except v, vi and ix. Now *Sideridis yu* Guen.

**L. venalba** Moore—Common. Records for i to iii, vii and x to xii. Now *Sideridis.*

**L. unipuncta** Haw.—Uncommon. Recorded in i and x to xii. Now *Sideridis.*

### AMPHIPYRINAE

**Magusa tenebrosa** Moore—Not uncommon, the nomino-typical form and also ff. *albistriga* Warr., *longistriata* Warr. and *bistriga* Warr. Records for vi, vii, and ix. Now *Sasunaga*.

**Eriopus xanthopera** Hamps.—A few larvae on ferns. Records for xi and xii. Not in Fauna.

**Calogramma festiva** Don.—Larvae very common on Amaryllidaceae in some years. Imagines rare. Records for iii, v, vii, viii, xi and xii.

**Prodenia littoralis** Bsd.—Very common, also larvae which are almost omnivorous. Recorded in i to iii, v and x to xii. Now *litura* F.

**Spodoptera mauritia** Bsd.—Very common. Recorded for all months except v. Larvae feed on grass.

**S. cilium** Guen.—Very common. Recorded for all months except iii to v. Larvae feed on grass. The Fauna includes this as a synonym of *Caradrina exigua* Hbn.

**S. pecten** Guen.—Common, recorded in xi and xii only but may have been overlooked as the previous species. Larvae on grass. The Fauna calls it *Caradina pectinata* Hamps.

**Athetis placida** Moore—One in vi. The Fauna treats this as a synonym of *Caradina quadripunctata* F.

**Prospalta dolorosa** Wlk.—One larva. Recorded for iii. Included among the synonyms of *Euplexia conducta* Wlk. in the Fauna.

**P. pallidipennis** Warr.—Larvae common on Coreopsis. Records for i, ii, ix and xi. Not in the Fauna.

**P. capensis** Guen.—Common, also larvae on Coreopsis. Records for all months except v and viii. Not in the Fauna.

**Nonagria inferens** Wlk.—Common. Records for i to iii and ix to xi. Now *Sesamia*.

**Chasmina rejecta** F.—Uncommon, recorded in iii and iv. Not in Fauna.

### ERASTRIANAE

**Eublemma hemirhoda** Wlk.—Uncommon, records for x only. Now *Polyorycta dimidialis* F.

**E. acontioides** Moore—Common. Records for ix, xi and xii. Now *P. pudica* Snell.

**E. olivacea** Wlk.—Uncommon. Larvae on Brinjal. Records for ii, vii and x. Now *Autoba*.

**E. abrupta** Wlk.—Uncommon. Recorded in xi only. Now *Autoba*.

**E. trifasciata** Moore—Uncommon. Records for vi and vii. Now *Porphyrinia.*

**E. divisa** Moore—Common, also ab. *derufata* Warr. Recorded in iii, iv, x, xi and xii. Now *Porphyrinia anachoresis* Wllgr. I have found the larva in Mombasa on a species of Malvaceae.

**E. amabilis** Moore—Fairly common. Records for i, ii, vi, ix, xi and xii. Now *Porphyrinia.*

**E. virginea** Guen.—Not uncommon. Recorded in ix, x, and xi. Now *P. ragusana* Frr.

**Zagira contentaria** Wlk.—One in x. Now *Cerynea.*

**Zagira divisa** Wlk.—Uncommon. Records for viii, x and xi. Now *Oruza.*

**Z. semilux** Wlk.—Uncommon. Records for viii, x and xi. The Fauna includes it with *divisa.*

**Corgatha zonalis** Wlk.—Common. Larvae found feeding on Lichens growing on the trunks of Palm trees. Recorded for all months except i, iv, v and vi.

**Swinhoea vegeta** Swinh.—Rare, recorded in x only.

**Metachrostis incondita** Btlr.—Common. Records for ix, x and xi. Now *Ozarba.*

**M. itwarra** Swinh.—Not common. Records for x and xi. Now *Ozarba.*

**Amyna octo** Guen.—Common, also f. *axis* Guen. Recorded for all months except v and viii. Now *Ilattia.*

**Berresa natalis** Wlk.—Uncommon. Records for viii, ix, xi and xii. The Fauna gives it as a synonym of *B. turpis* Wlk., which it is not.

**Hyelopsis signifera** Wlk.—Common. Records for vii, ix, x and xi. Now *Maliattha.*

**Toxophleps optiva** Swinh.—Rare, recorded in x only. Now *Cophanta funestalis* Wlk.

**Naranga diffusa** Wlk.—Common. Records for x and xi.
**Tarache tropica** Guen.—Uncommon. Records for vii and viii. Now *T. marmoralis* F.

### MELICLEPTRIINAE

**Heliothis armigera** Hbn.—Very common, also larvae which are often pests on many garden flowers such as Antirrhinum, Carnations and Roses. Recorded in i, iii, iv and v. Now *Chloridea obsoleta* F.

**Chariclea marginalis** Wlk.—Uncommon. Records for vii, x and xii. Now *Adisura.*

**Adisura atkinsoni** Moore—Uncommon. Records for iii and iv.

### EUTELIANAE

**Eutelia jocosatrix** Guen.—Common. Records for i, ii, v, vi, ix, x and xi Now *Bombotelia.*

**E. nugatrix** Guen.—Common. Records for iv and viii. Now *Bombotelia.*

**E. favillatrix** Wlk.—Common. Recorded in vi, vii, x and xi.

**Chlumetia transversa** Wlk.—Common. Recorded in all months from vi to xii.

**Eutelia delatrix** Guen.—Common also f. *palliatrix* Guen. Larvae on *Eugenia* sp. Records for vi, vii and ix. Now *Phlegetonia.*

**Anuga constricta** Guen.—Uncommon. Records for x, xi and xii.

**Ingura subapicalis** Wlk.—Common. Recorded in v to viii and xi. Now *Paectes.*

### STICTOPTERINAE

**Odontodes aleuca** Guen.—Common, but with very little variation. Records for vii and viii.

**Stictoptera cuculloides** Guen.—Rare, recorded in vi only.

**S. illucida** Wlk.—Rare. Records for vii and x. Now *Lophoptera.*

### SARROTHRIPINAE

**Sarrothripa nolalella** Wlk.—Bred from larvae off *Lagerstroemia* spp. Records for v and x. Now *Symitha.*

**Nanaguna breviuscula** Wlk.—Common. Records for iii, ix and xi. The Fauna calls it *Cletthara nigridisca* Hamps.

**Plotheia celtis** Moore.—Very common, also larvae on *Lagerstroemia indica.* Records for all months except iii, iv and v. Now *Selepa.*

**Barasa acronyctoides** Wlk.—Common. Recorded in vi and viii to xi.

**B. alopha** Hamps.—Uncommon. Records for iii only. Not in Fauna.

**Gyrtona pusilla** Moore—Common. Records for vii and ix. Now *Gyrtothripa.*

### ACONTIINAE

**Earias fabia** Stoll.—Common. Recorded in vii, x and xii. The Fauna treats this and the following three species in the Arctiidae.

**E. luteolaria** Hamps.—One in xii.

**E. cupreoviridis** Wlk.—Common. Records for x and xii.

**Paracrama dulcissima** Wlk.—One in i.

**Pseudelydna rufoflava** Wlk.—Rare. Recorded in vii and x.

**Capotena apriformis** Wlk.—One in ix. Now *Aiteta.*

**Carea subtilis** Wlk.—Common. Records for all months but i, iv, vi, vii and xii. Now *C. angulata.*

**Beara dichromella** Wlk.—Uncommon. Larva on *Zizyphus jujuba.* Recorded in x, xi and xii.

**Acontia intersepta** Guen.—Uncommon. Recorded in vii only.

**A. graellsi** Feisth.—One only in xi.

### CATOCALINAE

**Nyctipao hieroglyphica** Drury—One beaten from herbage in x.

**N. macrops** L.—One in vi.

**Entomogramma fautrix** Guen.—One in vii.

**Spieredonia helicina** Hbn.—One in ii. Treated by the Fauna as a synonym of *Spirama retorta* L.

**Ophiusa dotata** F.—Uncommon. Records for vii and viii. Now *Lagoptera.*

**O. coronata** F.—Common. Also larvae on *Quisqualis indica.* Records for i, v and vii to xii. Now *Anua.*

**Ercheia cyllaria** Cr.—Not uncommon. Records for vi, x, xi and xii.

**Ophiusa serva** F.—Fairly common. Recorded in v, vi, x and xii. Now *Achaea.*

**O. melicerte** Drury—Common. Larvae on Castor and occasionally on Rose. Recorded in iii, vi and x. Now *Achaea janata* L.

**O. illibata** F.—Uncommon. Records for viii only. Now *Parallelia.*

**O. joviana** Cr.—Rare, in viii only. Now *Parallelia.*

**O. conficiens** Wlk.—Rare, in x only. Now *Parallelia.*

**O. stuposa** F.—Uncommon. Records for vi, vii and ix. Now *Parallelia.* The Fauna treats as a synonym of *algira.*

**O. arctotaenia** Guen.—Rare, in x only. Now *Parallelia.*

**O. algira** L.—Common, also larvae on Castor. Records for vi, vii, and viii. Now *Parallelia.*

**Trigonodes ino** Drury—Common. Larvae on Peepul. Records for iii and iv. Now *Attatha.*

**Grammodes geometrica** F.—Common. Records for ii, iv and xi.

**G. mygdon** Cr.—Common, also in herbage. Records for ix, x and xi. Now *Euclidisema.*

**Trigonodes hyppasia** Cr.—Common, also in herbage. Records for ii and vii to xii. Larvae on *Rhynchosia minima* (Papilionaceae). Now *Chalciope.*

**T. cephise** Cr.—One in xi. Now *Chalciope.*

**Remigia frugalis** F.—Common, also in herbage. Larvae on grass. Records for all months except iii, iv, v and ix. Now *Mocis.*

**R. archesia** Cr.—Common, also in herbage. Larvae on *Rhynchosia minima.* Records for x, xi and xii. Now *Mocis undata* F.

**Anisoneura hypocyanea** Guen.—Rare. Recorded in ix and x.

**Pericyma glaucinans** Guen.—Not uncommon. Records for x and xi.

### PLUSIINAE (NOW PHYTOMETRINAE)

**Plusia jessica** Btlr.—Not uncommon. Larvae on Antirrhinum flowers. Records for ii, iii, vii, viii, x, xi and xii. *Plusia* has now been replaced by *Phytometra.*

**P. eriosoma** Dbl.—Common. Larvae on Hollyhock. Records for i, ii, vi, vii, viii, x, xi and xii.

**P. ochreata** Wlk.—One in ix.

**P. lectula** Wlk.—One in xi.

**P. orichalcea** F.—Common. Recorded in i, ii, iii and x.

### NOCTUINAE

**Cosmophila sabulifera** Guen.—Uncommon. Larvae on Malvaceae. Recorded in ix only.

**C. erosa** Hbn.—Common. Larvae on Hollyhock. Records for all months except iii, v and vi.

**Hypocala subsatura** Guen.—Rare, recorded in xi only.

**H. deflorata** F.—Rare, in xii only.

**H. moorei** Btlr.—Uncommon. Records for ix and x.

**Sericea feducia** Stoll.—One in vi.

**Pandesma mundata** Wlk.—Rare, in iii only.

**P. quenavadi** Guen.—Common. Records for iv, v and vi.

**Polydesma umbricola** Bsd.—Common. Larvae on *Albizzia* sp. Records for all months except ii, iii and iv.

**P. inangulata** Guen.—Common. Larvae on *Cassia fistula.* Records for vi, viii, x and xi. Now *Ericeia.*

**Hulodes drylla** Guen.—Not uncommon. Records for vi and vii.

**Catephia linteola** Guen.—Uncommon. Recorded in i, ii, iii, vi and xii.

**Sphingomorpha chlorea** Cr.—Uncommon. Recorded in ii and xi.

**Lacera alope** Cr.—One only in xi.

**Plecoptera reflexa** Guen.—One in ix.

**Acantholipes trajectus** Wlk.—Uncommon. Records for ii, iii and xi.

**Gesonia obeditalis** Wlk.—Common, also f. *nigrofusca* Swinh. Records for x, xi and xii.

**Dragana pansalis** Wlk.—Common, also in herbage. Records for i, ii, iv, vi and ix to xii.

**Fodina pallula** Guen.—Common in herbage. Larvae on an unidentified creeper. Recorded in iii, ix and x.

**F. stola** Guen.—Not common. Records for iii, vi and vii.

**Azazia rubricans** Bsd.—Common, also in herbage. Records for i, iii and x to xii.

**Ophideres salaminia** F.—One in vii. Now *Maenas.*

**O. materna** L.—Common. Larvae on *Tinospora cordifolia.* Records for ix and xi. Now *Argadesa.*

**O. fullonica** L.—Common. Larvae on *T. cordifolia.* Records for vi, vii, ix, x and xi.

**Calpe emarginata** F.—Uncommon. Records for iv, viii, x and xi.

**C. minuticornis** Guen.—One in xii.

### HYBLAEINAE

**Hyblaea puera** Cr.—Common, also larvae. Records for v, vii, viii and ix.

### FOCILLINAE

**Zethes ocellata** Moore.—Uncommon. Records for x and xi.

**Egnasia ephyrodalis** Wlk.—Common. Records for vi to x.

**Raparna digramma** Wlk.—Rare. Records i and xi.

**R. imparata** Wlk.—Fairly common. Records for v, viii, x and xi.

### DELTOIDINAE

**Libisosa robustalis** Guen.—Common. Recorded in ii and from v to xi.

**Nodaria externalis** Guen.—One in iii.

**Dichromia orosia** Cr.—In herbage, uncommon. Records for x only.

**Hypena masurialis** Guen.—Not uncommon. Recorded in x, xi and xii.

**H. rectivittalis** Moore—One f. *specualis* Swinh. in xi.

**H. cognata** Moore—Common. Records for vii, viii, x and xii.

**H. indicatalis** Wlk.—Not uncommon. Records for i only.

**H. ignotalis** Wlk.—Fairly common. Records for ii and from vi to xii.

**Rhaesena transcissa** Wlk.—One in iii.

There remain the following two species, which do not appear in either Hampson's Catalogue of the Lepidoptera Phalaenae or in Seitz' Indian Noctuidae :

**Rivula bioculalis** Moore—Common. Recorded in xi. The Fauna places this in Acontiinae.

**Nolasena ferrifervens** Wlk.—One or two every year in vi. Placed in the Sarrothripinae in the Fauna.

(*To be continued*)

# COVERING KANHA WITH A CAMERA

BY

A. S. TALATI, B.SC. (HONS.)

(*With two plates*)

These notes are primarily intended for the nature photographer visiting Kanha for the first time. It is assumed that the man behind the camera is versatile, both with the instruments he is handling and the art of stalking wild animals in their natural habitat. Jungle photography in India amongst other things calls for the highest skill in a person, the best available material to work with, and patience to a degree where it can get nerve-racking.

The trip to Kanha National Park even from a place within the State is a feat in itself. Over dusty third-class roads it is a nightmare affair for any photographer who cares for his equipment. These have to be sealed up so securely that not a speck of dust can get at them till you reopen the packages at the forest rest house. This of course entails the risk of losing some pictures, rare ones at times, which you might get from the time you enter the park limits to the time you reach the rest house. Jungle photography in India is difficult enough without these added strains which our National Park imposes on us.

I had visited Kanha on two previous occasions before it had been brought to the status of a National Park, and on both these occasions I had dabbled in monochrome pictures. This time I was working with colour stills. One must have plenty of time at one's disposal for photographing wild life. For photographing wild life at Kanha the first requisite is time. A week is the minimum period I set for an assignment at Kanha, though I myself have never been able to indulge in the luxury of an extended holiday so far. I have worked more or less over week-ends. Visiting Kanha for the first time will take you at least a couple of days to familiarise yourself with the terrain and the animal life. A couple of days with monochrome to get your eye in, and thereafter you will be ready to shoot in colour.

Light in Indian jungles, and particularly sal forests, can be very deceptive and difficult for colour work. A box camera is no use. You would be wasting your time and money with anything less than f. 5.6 and speeds slower than 1/100 sec. In jungle photography both the camera and the man behind it count. Get the finest equipment you can afford, get to know it like the palm of your hand, and then put it to best use with the working knowledge you already possess.

Kanha National Park can afford some outstanding scenic and animal shots to an enthusiastic photographer. I have worked with a Rolleiflex, a Contax III fitted with a 135 mm. tele, a Graflex fitted with a 10″ tele, and a Primarflex fitted with 200 and 400 mm. teles, in addition to a Bell and Howell 16 mm. cine. I gave up cine pictures. Unless you give them the professional touch, you don't get your money's worth, and I neither had the touch nor the money to make any effort worth while. I therefore chose the next best—colour stills. I like working with bigger negatives, though a 35 mm. camera is more versatile in the jungles. The Graflex I found too big and cumbersome, so finally I gave up all in favour of the Primarflex with its 200 and 400 mm. tele-lenses. From my photographer friend Isadore A. Berger, F.P.S.A., F.R.P.S., of Detroit I have, among other things, learnt always to use a tripod, even at 1/200 sec. But in photographing wild life I discovered before long that there was never time to fiddle about with a camera on a tripod. To hold a 400 mm. lens steady you need a sturdy tripod. A gadget like that has to be big and cumbersome. So invariably I depended on either the car bonnet, or the branch of a tree, or a stone, or at times even my knees. I could never work at speeds less than 1/100 sec. The ones I had to take at 1/50 sec. due to bad lighting conditions were invariably found to have been shaken. I worked with f. 5.6 most of the time. The depth of focus at this opening is very discouraging and the focussing of the main subject has to be done very critically. Animal subjects in the jungle are not half as obliging as studio models. They dislike close approach and trying to outwit them in stalking would be living in a fool's paradise. I therefore decided on photographing them even from 150 to 200 yards. The 400 mm. tele bridged the gulf between us remarkably well. Each Ektachrome and Ansco roll provided twelve exposures and in two days I took over a hundred pictures sometimes at machine-gun speed.

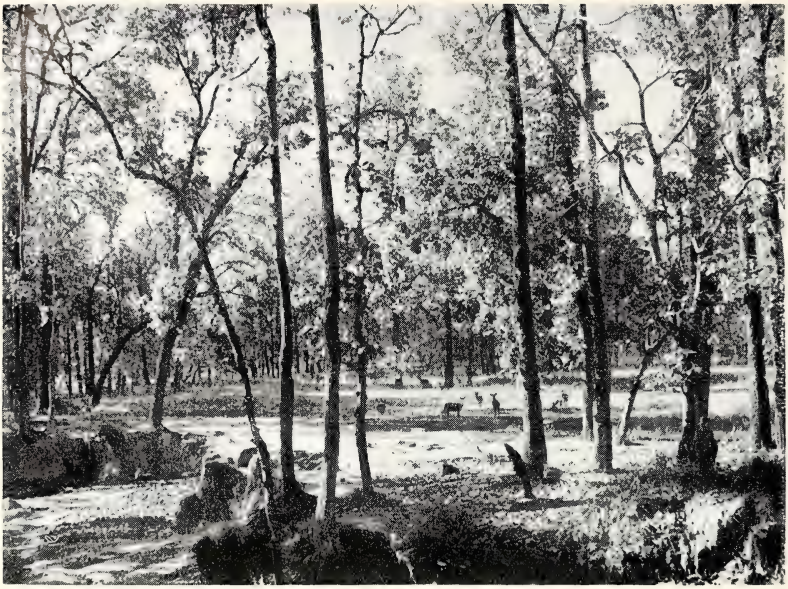
Most of the animals come out for grazing during the morning and evening hours. I had not the luck to see carnivora during day time, but friends have reported having occasionally seen tigers and panthers along the Kisli-Kanha road. The deer, antelope, wild boar, wild dogs, peafowl, junglefowl and other bird life are quite obliging during daylight hours. I found the best time to photograph animals was between 3.30 and 5.30 in the afternoon. If you prefer misty effects early morning time is better, but in winter the grass is much too high and wet to make walking through it comfortable.

I favour the use of exposure meters. Get the best one you can but don't depend on it all the time. Having once got the general idea of the lighting conditions of your locality, try and use your judgment and previous experience while indulging in quick shooting. Otherwise you will find the animal giving you a prize picture pose while you have the meter on it and give you its back when you are ready to shoot. There are a lot of open maidans in this Park. Most of your shooting will be done in good sunlight. Get the sunlight flat on the subject if you want good colour prints and enlargements. For melodramatic effects and salon pictures you have to work against the light and with the light at all odd angles. If you go off the beaten track you will get lighting conditions that you wished didn't exist. That's where your skill comes in, and the versatility of the camera. Add to all these natural disadvantages and inconveniences the obstacles left by the Park management. There is a fine salt lick on which to photograph animals without their being aware of your presence. A nice hide-out with a closed-in passage leading up to it

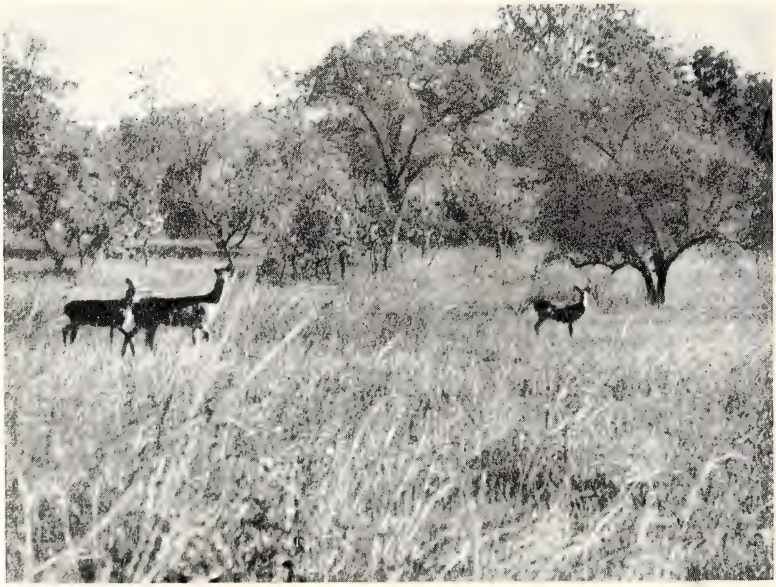
View from Kanha Rest House

Cheetal in a typical maidan, Kanha

(*Photos: A. S. Talati*)



Cheetal approaching the salt lick, Kanha



Barasingha hinds, Kanha

(*Photos: A. S. Talati*)

have been provided by the forest department. But that is about all —and that is not enough. The passage leading up to the hide-out is strewn with dried leaves most of the time. They never seem to clear the passage of these dried leaves. Walking on them is like walking over tin foil. Either you walk on them at the risk of disturbing game or pick them up diligently, as we did, one by one and clear the way. When you are out shooting either with a gun or a camera and intend to do it seriously, a thing like this can get on your nerves. Having reached the hide-out it was a problem for me to get my 400 mm. lens through the small aperture provided. I had to widen one of the holes in order to get the lens through. With the light intensity almost zero within the hide-out and brilliant sunlight behind the cameraman, animals in and around the salt lick have no trouble in locating the intruder at the slightest movement. We spent hours at the salt lick but hardly got one or two shots, each time the animal getting suspicious and scampering away even before we had time to say hello to it.

There is another salt lick at Srawantal but this place has no hide-out for the photographer's convenience. You might risk it on the off-chance of catching an animal unawares on it—I am yet to see even the keenest sportsman on foot whether with a gun or a camera do that.

Srawantal is a beautiful spot to photograph. Animals come there, during midday particularly, for a drink. With a little bit of luck you can get good pictures here. But luck was evidently not with me the day I was trying out my patience. My pal and I, each with a camera, sat for two hours enduring patiently the heat of the midday sun for our wild friends to appear and then, just as a huge crowd of barasinghas was approaching the pond, two forest guards came talking loudly, drowning their own voices as they walked on the dry leaves with their heavy jungle boots. The barasinghas were off like a shot while the forest guards approached us most unconcerned and stood there so stupid and dumb that they gave one the impression of being just bone from their necks up. A hide-out in the centre of the tank, with arrangements to approach it, would be ideal for the cameraman.

Kanha National Park, beautiful in its natural grandeur and rich in its animal life, still is a far cry, I think, from the National Parks such as the Glacier, the Yellowstone or the Yosemite, which it has been my good fortune to see. These notes as I said are primarily intended for the photographer wishing to cover Kanha with his camera. Therefore I do not wish to go off the subject matter and involve myself in discussing the merits and demerits of Kanha as a National Park. I would like to say, though, that it could do with a lot of improvement and care, which are at present lacking. The roads are practically non-existent, domestic cattle abound within the park area, wild life is in danger of depletion by wild dogs which are ever on the increase, forest roads, paths and tracks leading up to salt licks are strewn with dried leaves, and facilities are lacking for any tourist to spend a day comfortably at the rest house. No facilities exist for refuelling the car. Not even a Khansama is attached to the rest house, while every P.W.D. rest house in M.P., however humble it be, will at least have a cook and a sweeper. The photographer, in addition to carrying his equipment and stacks of film rolls, will be required to carry his own bazar and tin provisions, and also a cook and a bearer if he is fastidious. A small stall, which sells camera films and other cheap accessories, I think would be very useful if it were attached to the present rest house. No route maps, no literature on the flora and fauna of the park, no guides—nothing is available. You start from scratch and are your own research student. You just get to know the place by the time you are ready to leave. If somebody from the forest department meets you it is usually a petty official and he is of such a calibre and class that you would be better off without his assistance. Kanha as a National Park deserves better treatment than this, surely.

With all these handicaps I say to my photographer friends do not be discouraged. In our new-born Republic Kanha is still a bud. We hope that it will be nursed and taken care of. A photographic trip to Kanha today is a hard and expensive venture, but worth while all the same if you don't mind roughing it out a bit. You may not reap a rich harvest with your camera the first time, but out of a few hundred pictures that you take a handful will be worth preserving and reminiscing over. Even if by some miracle you manage to reach Kanha by bus and bullock cart, or trudge the last mile on foot, you will still need a car to go round within the Park. Any car will do. At various times I have taken my pictures from the hood and the bonnet of a Hillman, a Chrysler and a Dodge suburban. But I prefer a jeep to all these for real close up work. Try stalking the animals on foot and they start moving away from a mile off. In a jeep I have found they let you come as close as within ten feet at times. At Yellowstone I could feed bears and literally shake hands with them, but the Kanha animals are not that friendly yet. In photographing wild life, as in hunting, team work pays good dividends. You cannot expect to drive the jeep and take pictures, all at the same time. You must have a pal who besides being a driver for you literally knows what is going on in your mind. Whenever we spotted mixed herds of blackbuck, cheetal, barasingha, I would just have to tell him 'cheetal, 25 ft., side lighting', and he would get me into position; meanwhile I was ready set with my aperture, speed, and distance settings on the camera. This way I was lucky in recording quite a few good shots.

A photographer like a hunter has to be prepared for many disappointments. I lost more good pictures than I got. At times I would come to the end of a film just when we would witness a rare fight between a vulture and a wild dog over the latter's kill. It is all over in a matter of a few seconds. Unfortunately, I cannot unload and reload my camera that fast. A 35 mm. gives you 36 exposures and would be an asset at such times, but I prefer my $2\frac{1}{4} \times 2\frac{1}{4}$ and have consequently suffered at odd times. If you can manage two cameras and two teles with an assistant to help you load and reload, you can save yourself many a disappointment. Photography is an expensive hobby, but I do not intend to make it that expensive. I have had to depend on my limited resources and the assistance of those who accompanied me on this trip; also, the Divisional Forest Officer who made it possible for me to occupy the forest rest house for three days and nights. Without the combined assistance of all these people my photographic trip to Kanha would have been a washout. Whatever efforts you see recorded here must be considered the collective effort of a few and not of one individual. Pursuing wild life at Kanha calls for at least a doubles game, if not team work on a larger scale. A singles game here would be downright disappointing. The forest department has provided an elephant for going round the Sanctuary. I don't think you can get closer to animals on an elephant than in a jeep. At least it has not been my experience. But I prefer to work from the jeep or when necessary to get out quickly on foot. For one thing the elephant is a very slow moving object and the deer species run circles round it. Secondly sitting on an elephant presents an Empire State Building view of the animals down below—a very awkward angle for the camera I think. I like low angle shots, and where that is not possible even straight and level, but never where I have to look down on the animal unless I am shooting with a gun.

I have often been asked about the best time of the year to take pictures at Kanha. That is rather difficult to answer. For my part I would say given average conditions I like to photograph when I am in the mood for it. If I don't feel like photographing wild life, given even the ideal conditions I would produce very mediocre results. Also, to be able to photograph wild life, whether at Kanha or any other jungle, one must above everything possess enduring love for Nature and wild life. Photographing wild life is not just clicking the camera shutter; your heart must click with it. Any time from November to June is good enough for Kanha. Early winter the grass is a bit too high and the jungle a bit too thick. End of February or early March I found as providing ideal conditions for colour work. The sal forest is aflame with colours at this time of the year. If you are after cloud effects, April and May I found to be about the best months. No matter which time of the year it is, Nature at Kanha will always fascinate you—the animal life, the bird life, the insect life, the plant life combine in a mystifying harmony fabricating a picture that will at its worst far surpass any human effort with the best of lenses and the best of emulsions.

# MODES OF COPULATION IN SHORT-HORNED GRASSHOPPERS (ORTHOPTERA: ACRIDIDAE)

BY

K. N. Katiyar, M.SC.

(*From the Branch of Entomology, Forest Research Institute, Dehra Dun*)

(*With a plate*)

## Introduction

Very little research work has been done on the copulation of the Acrididae, especially of India. Kunckel d'Herculais (1893-1905) described copulation in the Desert Locust, *Schistocerca gergaria,* and Fedorov (1927) in the Egyptian grasshopper, *Anacridium aegyptium* Linnaeus. Later on, Uvarov (1928) gave a detailed account of the common mode of Acrideid copulation (Mode I or 'riding mode' of present account) in *Schistocerca gregaria.* Jhingran (1944) recorded another mode of copulation (Mode II or 'lateral mode') in *Choroedocus insignis* Thunberg. Katiyar (1952) recorded a third mode of copulation (Mode III or 'hanging mode') in *Parahieroglyphus bilineatus* Bolivar. A critical study of the various modes of copulation suggested that a correlation exists between the relative body-length of the two sexes and the modes of copulation adopted. This is discussed below.

The present account deals with the study of the different modes of copulation in 16 species of Acrididae found around Dehra Dun (Table I). Copulation was observed in the insectary cages as well as in the field under natural conditions.

## Modes of Copulation in Relation to the Ratio of the Body-size of the Two Sexes. (Table I)

Three main types of copulation have been described so far (*vide supra*). Katiyar (1952) suggested that during copulation the various changes in the position of the males are due to the mechanical difficulty of the male in introducing his aedeagus into the vagina of the female and that this feature is correlated with body-length. When the ratio of ♀ : ♂ body-length[1] is about 1.07, as in *Schistocerca gregaria*, copulation is by Mode I ('riding mode'). When the ratio is about 1.51 as in *Choroedocus insignis,* copulation is by Mode II ('lateral mode'). When it is about 1.72 as in *Parahieroglyphus bilineatus* Bolivar, copulation is by Mode III ('hanging mode').

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[1] This ratio was calculated as follows: Length of the entire body of female, Length of the entire body of male.

These correlations exist in the 16 species studied, as discussed below. The most common mode of copulation is Mode I. Ten species copulated by Mode I, but showed gradual variation depending upon the increase in the ratio of ♀ : ♂ body-length; thus *Schistocerca gregaria* (with the lowest ratio, 1.07) shows the perfect type of Mode I. In this species the male is almost equal in length to the female. The head of the male lies just above the occiput of the female during copulation, and when he lowers his abdomen the aedeagus finds its way into the genitalia of the female easily (Pl., fig. *a*). This can be taken as the most comfortable posture for the male. The other 9 species (Nos. 2-10, Table I) with the Mode I type of copulation show a gradually increasing variation in the formation of the loop or twist in the male abdomen to achieve coitus, and this is correlated with the above-mentioned ratio. Not only the loop or twist in the abdomen of the male increases gradually as the ratio increases, but also the position of the male changes, the head of the male gradually moves backwards as the ratio increases (Pl., figs. *b-d*). The ratio is 1.07 in *Schistocerca gregaria*, 1.25 in *Hieroglyphus nigrorepletus*, 1.27 in *Aularches punctatus*, 1.33 in *Eyprepocnemis roseus*, 1.35 in *Spathosternum prasiniferum*, 1.36 in *Ceracris deflorata* and 1.38 in *Hieroglyphus banian*, *Hieroglyphus concolor*, *Cantantops humilis* and *Chrotogonus concavus*.

In *Phlaeoba panteli* (ratio 1.4) the male does not remain on the back of the female as in Mode I, but comes to lie on the dorso-lateral side of the abdomen of the female, with his head just near the hind-femur of the female (Pl., fig. *e*). It forms an intermediate link between Modes I and II and shows a 'dorso-lateral' mode of copulation.

In *Choroedocus insignis*, Jhingran (1944) recorded the 'lateral' mode of copulation (Mode II) in 4 pairs in the laboratory; the male comes to lie on the lateral side of the female forming an acute angle with the female (Pl., fig. *f*). The present author has observed this mode in about 200 pairs in the field and in about 40 pairs in the Insectary. Besides this species, this mode of copulation was also observed in another species, *Choroedocus* sp., in three pairs in Bibiwala Forest near Rishikesh (Uttar Pradesh). The ratio of the body-length of the two sexes in these species is 1.51 and 1.52 respectively.

In *Gastrimargus transversus* Thunberg, 2 pairs were observed copulating by 'dorso-lateral' posture (the ratio of the body-length, 1.42). Four other pairs showed copulation by 'lateral posture' (ratio 1.53), and in 4 other pairs the males showed 'hanging posture' when copulating on a leaf; when copulating on the ground, the male forms an obtuse angle with the body of the female during copulation (ratio 1.61). Thus, in the same species as the ratio rises the mode of copulation changes from the dorso-lateral to lateral (Mode II), and from the latter to the hanging type (Mode III).

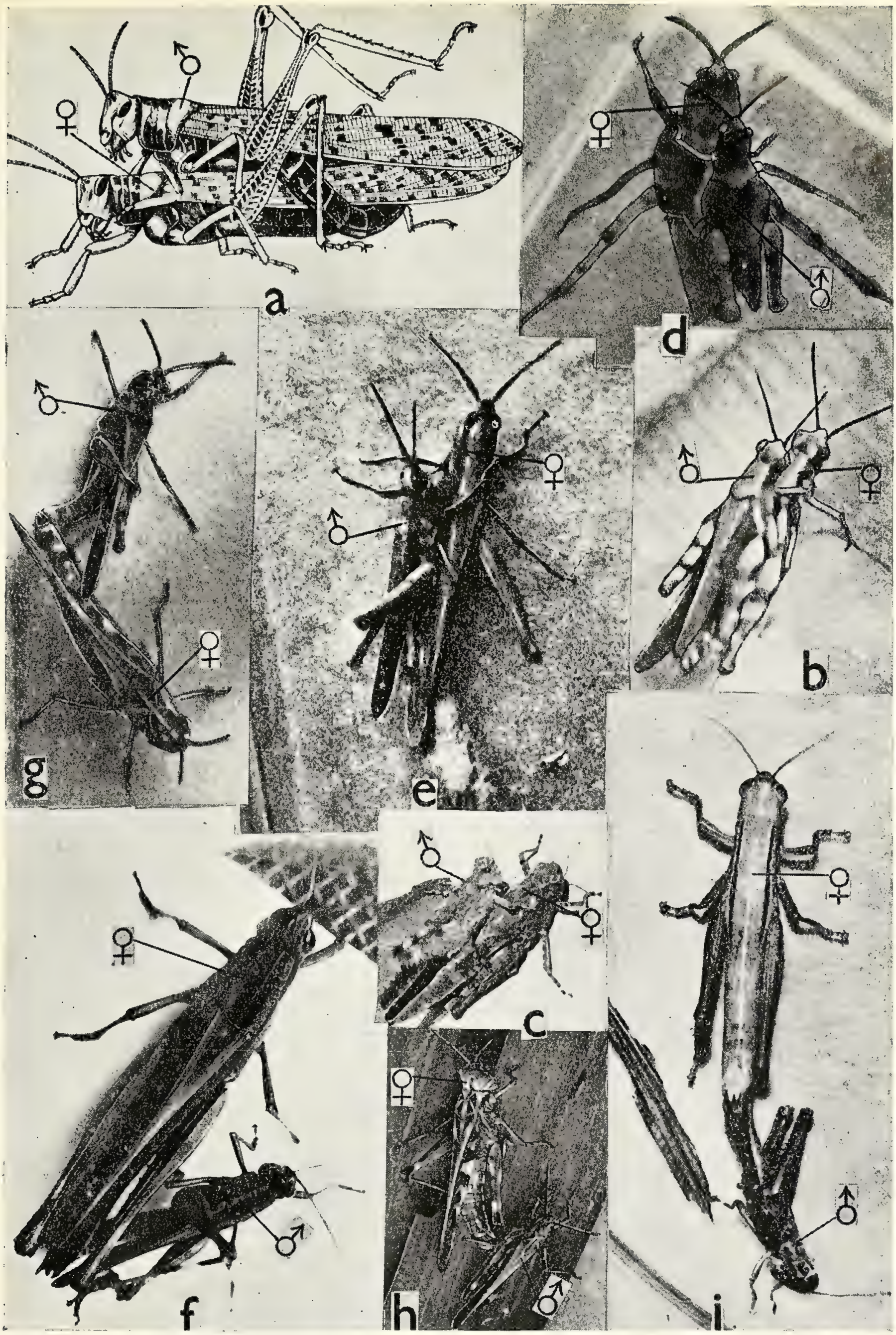
In *Oedaleus abruptus* (ratio 1.58), during copulation the abdomen of the male forms a curve with the abdomen of the female; or he comes to lie on the opposite side of the female (Pl., figs. *g*, *h*), forming an obtuse angle with the body of the female as in *Gastrimargus transversus* (when the ratio was 1.61). But in neither

TABLE I

Correlation between relative body-size of the two sexes and the mode of copulation in Acrididae.

| Species | Female | | Male | | Ratio | Mode of copulation |
|---|---|---|---|---|---|---|
| | No. of counts | Average body length in mm.* | No. of counts | Average body length in mm.* | In body length | |
| 1. *Schistocerca gregaria* Forskal ... | 5 | 58·42 | 5 | 54·50 | 1·07 | Mode I 'riding'. |
| 2. *Hieroglyphus nigrorepletus* Bolivar ... | 8 | 40·70 | 8 | 32·70 | 1·25 | Copulated by Mode I, but showed gradual variation, depending upon the increase in the ratio of the body length. |
| 3. *Aularches punctatus* Drury ... | 19 | 55·50 | 19 | 43·70 | 1·27 | |
| 4. *Eyprepocnemis roseus* Uvarov ... | 10 | 25·40 | 10 | 18·90 | 1·33 | |
| 5. *Spathosternum prasiniferum* Walker ... | 15 | 19·04 | 15 | 14·05 | 1·35 | |
| 6. *Ceracris deflorata* Brumer... | 7 | 29·70 | 7 | 21·80 | 1·36 | |
| 7. *Hieroglyphus banian* Fabricius ... | 12 | 40·50 | 12 | 29·20 | 1·38 | |
| 8. *Hieroglyphus concolor* Herbst ... | 14 | 54·25 | 14 | 39·10 | 1·38 | |
| 9. *Catantops humilis humilis* Serville ... | 17 | 29·30 | 17 | 21·20 | 1·38 | |
| 10. *Chrotogonus concavus* Kirby ... | 18 | 18·17 | 18 | 13·11 | 1·38 | |
| 11. *Phlaeoba panteli* Bolivar ... | 10 | 27·60 | 10 | 19·70 | 1·40 | 'Dorso-lateral mode' or between Modes I & II. |
| 12. *Choroedocus insignis* Thunberg ... | 32 | 59·50 | 32 | 39·50 | 1·51 | Mode II or 'lateral'. |
| 13. *Choroedocus* sp. ... | 3 | 50·50 | 3 | 33·15 | 1·52 | |
| 14. *Gastrimargus transversus* Thunberg ... | 2 | 36·10 | 2 | 25·40 | 1·42 | 'Dorso-lateral'. |
| | 4 | 37·50 | 4 | 24·60 | 1·53 | Mode II 'lateral'. |
| | 4 | 37·42 | 4 | 23·25 | 1·61 | Between Modes II and III. |
| 15. *Oedaleus abruptus* Thunberg ... | 8 | 23·18 | 8 | 14·52 | 1·58 | Between Modes II and III. |
| 16 *Parahieroglyphus bilineatus* Bolivar ... | 25 | 36·90 | 25 | 21·40 | 1·72 | Mode III or 'hanging'. |

* (*Measurements were taken in actually copulating pairs in the Insectary as well as in the field*)



EXPLANATION OF PLATE

(*a*) *Schistocerca gregaria* Forskal in copulation (After Kunckel, reproduced from Uvarov, 1928).

(*b*) *Catantops humilis humilis* Serville in copulation.

(*c*) *Sphingonotus indus* Saussure in copulation on a leaf.

(*d*) *Chrotogonus concavus* Kirby in copulation on the ground.

(*e*) *Phlaeoba panteli* Bolivar in copulation.

(*f*) *Choroedocus insignis* Thunberg in copulation (Original photograph by Dr. V. G. Jhingran, reproduced by his kind permission).

(*g*) *Oedaleus abruptus* Thunberg in copulation on the ground.

(*h*) *Oedaleus abruptus* Thunberg in copulation on a leaf.

(*i*) *Parahieroglyphus bilineatus* Bolivar in copulation on the ground.

The larger insect is ♀, the smaller ♂

case does the male turn upside down as in *Parahieroglyphus bilineatus* (see below). Thus, it is evident that *Oedaleus abruptus* also forms a link between Mode II (in *Choroedocus* sp., ratio 1.52) and Mode III (in *Parahieroglyphus bilineatus*, ratio 1.72).

Lastly, comes the 'hanging' mode of copulation as seen in *Parahieroglyphus bilineatus* Bolivar (Pl., fig. *i*). (For fuller description see Katiyar, 1952.) Here the ratio is 1.72, the highest among all the 16 species studied, the length of the female being nearly $1\frac{3}{4}$th that of the male.

## CONCLUSIONS

Based on the above discussion, the following are the brief conclusions:

(1) *Schistocerca gregaria* copulates by Mode I or 'riding'. The ratio of the ♀ : ♂ body-length is 1.07, which is the lowest in the present lot.

(2) As the ratio rises to 1.38, as in *Chrotogonus concavus* (Table I), the gradual backward shifting in the position of the male over the female also occurs.

(3) The curvature of the abdomen of the males also increases gradually with the variation in the position of the males in 'riding posture'.

(4) An intermediate mode of copulation between Mode I and Mode II has been observed in *Phlaeoba panteli* (ratio 1.40), where the male comes to lie in a 'dorso-lateral' posture on the side of the female.

(5) *Choroedocus insignis* and *Choroedocus* sp. (ratios 1.51 and 1.52 respectively) copulate by Mode II or 'lateral mode'.

(6) An intermediate mode of copulation between Modes II and III occurs in *Oedaleus abruptus* (ratio 1.58) and was also noted in a few pairs of *Gastrimargus transversus*, where the ratio rose to 1.61.

(7) In *Parahieroglyphus bilineatus* copulation occurs by Mode III or 'hanging mode'; the ratio is 1.72, the highest so far studied.

(8) In *Gastrimargus transversus* the intra-specific variation in the mode of copulation occurs as the ratio varies.

## SUMMARY

1. Various modes of copulation in 16 species of short-horned grasshoppers were studied as follows:

(*a*) *Schistocerca gregaria* shows a typical example of Mode I. Nine other species which also copulate by Mode I showed gradual variation, depending upon the increase in the ratio of body-length.

(*b*) *Phlaeoba panteli* shows an intermediate mode of copulation or 'dorso-lateral' posture between Modes I and II.

(*c*) *Choroedocus insignis* and *Choroedocus* sp. copulate by Mode II or 'lateral mode'.

(*d*) *Oedaleus abruptus* shows an intermediate mode of copulation between Modes II and III.

(*e*) *Parahieroglyphus bilineatus* shows a third mode of copulation (Mode III or 'hanging mode').

(*f*) *Gastrimargus transversus* shows considerable intra-specific variation in the mode of copulation, which varies from the dorso-lateral (Mode II), and from latter to the 'hanging type' (Mode III).

2. The modes of copulation hitherto described are correlated with the relative body-length of the two sexes in a species.

3. Some general conclusions from the above discussions are given.

## ACKNOWLEDGEMENT

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# FISHES OF KOLHAPUR

BY

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*(With a map and two text figures)*

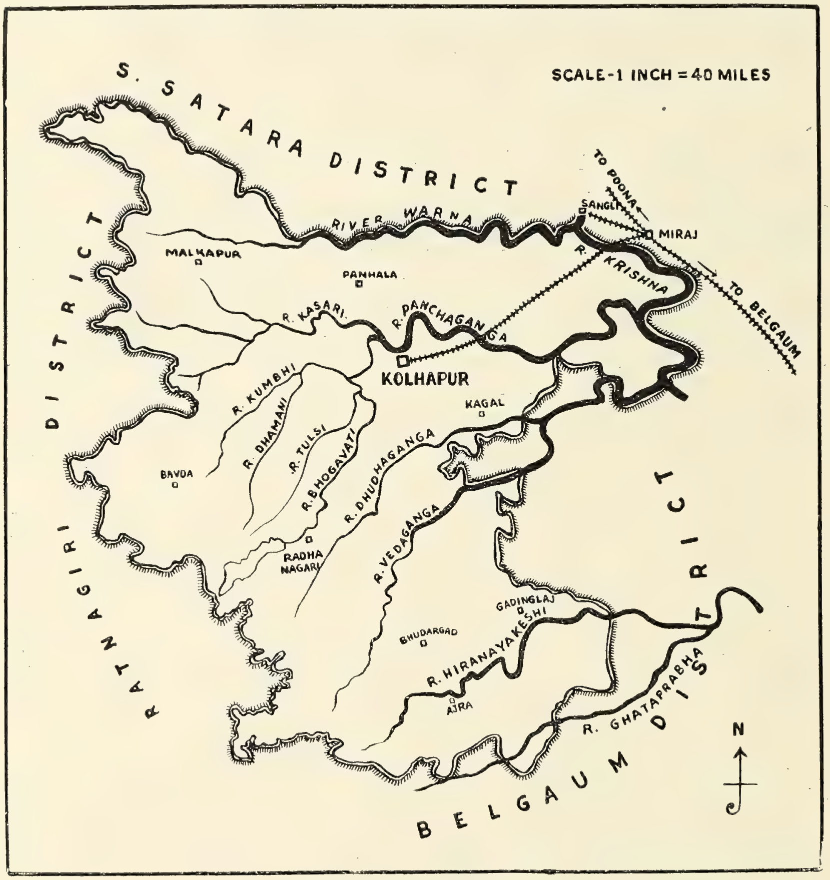
## INTRODUCTION

Very little is at present known about the fresh water fish fauna of Kolhapur District. The official gazetteer of the erstwhile Kolhapur State edited by Campbell (1886) contains only a few local names of fishes and a sketchy account of impressions about the 'Fisheries' as it was understood at that time. Campbell stated that the fisheries of the State (now the Kolhapur District) were of little importance. In making this statement, however, he appeared to have overlooked the vast potentialities of fresh water resources which have improved considerably during the last decade on account of the construction of new reservoirs and weirs across small rivers. Unfortunately, even the recent work on regional survey of Economic Resources, India, Kolhapur (Patil, 1950) has no mention of fisheries.

During the course of a survey of fresh water resources for the development of Inland Fisheries, efforts were directed to find a local source of supply of fish seed. Survey of sheets of water near Kolhapur indicated the availability of young ones of *Labeo fimbriatus* a fish locally known as 'Tambir', in large quantity. Presence of suitable tanks and reservoirs in this region brightened the scope for developing freshwater fisheries. In view of the aforesaid prospects of developing fisheries, a freshwater fisheries station was established by the Government of Bombay in 1951.

In this article, however, it is not intended to discuss the fisheries as an industry but only to record the fish fauna occurring in the waters of Kolhapur District. The need for such a check-list of fishes occurring in this area has long been felt, particularly in view of the prospects of developing fisheries in this part of the Deccan and the zoo-geographical significance (Kulkarni, 1951) of some of the species found in this region.

The district of Kolhapur is a part of the western Deccan Plateau lying along the eastern side of the Western Ghats. This district is bounded on the north by South Satara District, on the west by Ratnagiri District and on the south and east by Belgaum District. The physical features are of a varied nature consisting of plains, plateaus and hill ranges. Kolhapur District is traversed on the west by the long range of the Western Ghats which has thrown out several spurs in the east. The high altitude of these ranges and their copious rainfall have given rise to a number of streams and rivers which have formed small and large valleys. The drainage of the District is north-eastwardly and flows into the river Krishna. The important rivers of Kolhapur District are six in number, the Warna, Panchaganga, Dudhganga, Vedaganga, Hiranayakeshi and Ghataprabha. These rivers, which rise in the Western Ghats and flow south-east and north-east across the Kolhapur plateau towards the Krishna, have generally steep banks and soft with either clayey or rocky beds of varying depths. In the course of the first few miles of their course before they pass out of the mountainous terrain, the rivers are fed by numerous streams. Topographically the area covered by the District can roughly be divided into two zones marked by broad climatic differences (i) the western mountainous tract covered by the Western Ghats and its spurs, with valleys running in between the spurs, and (ii) the main


SCALE-1 INCH = 40 MILES
S. SATARA DISTRICT
TO POONA
SANGLI
MIRAJ
TO BELGAUM
RIVER WARNA
R. KRISHNA
MALKAPUR
PANHALA
R. KASARI
R. PANCHAGANGA
KOLHAPUR
KAGAL
R. KUMBHI
R. DHAMANI
R. TULSI
R. BHOGAVATI
R. DHUDHAGANGA
R. VEDAGANGA
BAVDA
RADHA NAGARI
GADINGLAJ
BHUDARGAD
R. HIRANAYAKESHI
AJRA
R. GHATAPRABHA
RATNAGIRI DISTRICT
BELGAUM DISTRICT
N

Kolhapur District

eastern plain. The elevation above sea level in the hilly west varies from 1850 ft. in the valleys to 3,000 ft. on the crest of Western Ghats. The elevation in the eastern plains varies from 1,800 to 1,900 ft. above sea level. Like the rest of the western Deccan, the climate of the District, being under the influence of the sea breeze, is mild and temperate. The range of temperature between the maximum and minimum is comparatively small. The maximum temperature in the hot season seldom rises above 100°F. and the minimum in the cold season rarely falls below 55°F., except at Kolhapur where it is sometimes 48°F.

Like the western districts of the Bombay Deccan, Kolhapur District receives its rain mainly from mid-June to December; the greater part of the rainfall, supplied by the south-west monsoon, is received from mid-June to mid-October. From about mid-October the eastern part of the District gets showers of the north-east monsoon. The rainfall varies according to altitude; the higher altitudes in the north get more rain than the comparatively lower altitudes in the south. The variations in the rainfall from west to east, however, are very marked. Bavda region in the western tracts gets 277 inches, whereas Kolhapur, Hatkalangde and Shirol get only 39, 25 and 23 inches respectively.

Kolhapur District is plentifully supplied with water from quite a number of rivers, streams, natural lakes, irrigation tanks, reservoirs and perennial ponds. The numerous streams offer many sites suitable for dams and weirs. With the implementation of several new irrigation development schemes which have a direct or indirect bearing on fisheries, pisciculture is bound to gain more importance in this region.

Most of the collection of fish specimens was done in the river Panchaganga from Prayag, about three miles west of Kolhapur, to village Valivde about nine miles east of Kolhapur. The five streams, Tulsi, Kasari, Bhogavati, Bramhi and Kumbhi unite to form the Panchaganga at Prayag. The aforesaid tributaries of the Panchaganga rise in the Western Ghats and flow through a hilly tract before they unite to form the Panchaganga. Due to the construction of weirs on the Panchaganga, a considerable quantity of water is retained in the river, thereby affording suitable habitat for a large number of fish. Further, when the tributaries of this river become shallow after monsoon, fishes from these tributaries also migrate into the Panchaganga for shelter and forage. The part of the river Panchaganga between Prayag and the village Valivde forms a stretch of about 12 miles. The banks and the bed in the aforesaid portion of the river are rocky, sandy and at some places muddy. This portion of the river also has large deep pools where additional water is retained by means of construction of weirs near Kolhapur and Valivde village. When the sluice gates of the weirs are opened before the commencement of the monsoon, the river runs with a terrific turmoil. Hence the collection in the river Panchaganga made at different times of the year represents fish fauna of varied nature including bottom dwelling forms in swift as well as stationary waters. The list of the fishes collected by us is given below with both scientific and local Marathi names.

| No. | Scientific names. | Local Marathi names. |
|---|---|---|
| | Order : OPISTHOMI.<br>Family : MASTACEMBELIDAE. | |
| 1. | *Mastacembelus armatus* (Lacep.) | Vam, Vambat. |
| | Order : APODES.<br>Family : ANGUILLIDAE. | |
| 2. | *Anguilla anguilla* (Ham.) | Aheer. |
| | Order : EVENTOGNATHI.<br>Family : CYPRINIDAE.<br>Sub-family : Abramidinae. | |
| 3. | *Chela clupeoides* (Bl.) | Vadashi. |
| 4. | *Chela phulo* (Ham.) | Alkut. |
| | Sub-family : Rasborinae. | |
| 5. | *Barilius bendelisis* (Ham.) | Jhorya. |
| 6. | *Barilius evezardi* (Day) | Jhorya. |
| 7. | *Perilampus atpar* (Ham.) | Sonukli. |
| 8. | *Danio aequipinnatus* (McClelland) | Balooki. |
| 9. | *Brachy-danio rario* (Ham.) | ... |
| 10. | *Rasbora daniconius* (Ham.) | Dandai. |
| | Sub-family : Cyprininae. | |
| 11. | *Aspidoparia morar* (Ham.) | Amlee. |
| 12. | *Balitora shimogensis* | Phattar chittu. |
| 13. | *Puntius amphibius* (C. & V.) | Khavli. |
| 14. | *Puntius dobsoni* (Day) | Parag. |
| 15. | *Puntius kolus* (Sykes) | Kolshi. |
| 16. | *Puntius melanostigma* (Day) | ... |
| 17. | *Puntius stigma* (C. & V.) | ... |
| 18. | *Puntius sarana* (Ham.) | Khavli. |
| 19. | *Puntius ticto* (Ham.) | ... |
| 20. | *Puntius* (*tor*) *khudree* (Sykes) | Mhasheer. |
| 21. | *Puntius* (*tor*) *mussullah* (Sykes) | „ |
| 22. | *Puntius fraseri* (Hora & Misra) | Kadwi. |
| 23. | *Cirrhina fulungee* (Sykes) | Mulicha ganna. |
| 24. | *Cirrhina reba* (Ham.) | ... |
| 25. | * *Cirrhina mrigala* (Ham.) | ... |
| 26. | *Garra mullya* (Sykes) | Mallya. |
| 27. | *Garra bicornuta* (Rao) | „ |

* Exotic fish introduced in Kolhapur waters.

| No. | Scientific names | | Local Marathi names. |
|---|---|---|---|
| 28. | *Labeo boggut* (Sykes) | ... | Sandasi, Sandas. |
| 29. | *Labeo fimbriatus* (Bl.) | ... | Tambir. |
| 30. | *Labeo calbasu* (Ham.) | ... | Kanas. |
| 31. | *Labeo porcellus* (Heckel) | ... | Tambudki. |
| 32. | *Labeo bata* (Ham.) | ... | Tambti. |
| 33. | * *Labeo rohita* (Ham.) | ... | ... |
| 34. | * *Catla catla* (Ham.) | ... | ... |
| 35. | *Rohtee cotio* (Ham.) | ... | Bhongi. |
| 36. | *Rohtee vigorsii* (Sykes) | ... | Phankut. |
| 37. | *Rohtee ogilbii* (Sykes) | . | Vatani. |
| 38. | *Schizmatorhynchus* (*Nukta*) *nukta* (Sykes) | ... | Nakata. |
| | Family : COBITIDAE. | | |
| 39. | *Lepidocephalichthys guntea* (Ham.) | ... | Mori. |
| 40. | *Lepidocephalichthys thermalis* (C. & V.) | ... | ,, |
| 41. | *Nemachilichthys ruppelli* (Sykes) | ... | Chikli. |
| 42. | *Nemachilus denisonii* (Day) | ... | Murunga. |
| 43. | *Nemachilus botius* (Ham.) | ... | Chikli. |
| 44. | *Nemachilus* sp. ? | ... | Chikli. |
| 45. | *Botia striata* var. *kolhapurensis* nov. | ... | Waghamasa. |
| | Order : NEMATHOGNATHII.<br>Family : SILURIDAE. | | |
| 46. | *Ompok bimaculatus* (Bl.) | ... | Wanz |
| 47. | *Ompok pabo* (Ham.) | ... | Kaliwanz. |
| 48. | *Wallago attu* (Bl.) | ... | Valashivda. |
| | Family : BAGRIDAE. | | |
| 49. | *Mystus cavasius* (Ham.) | ... | Katirna. |
| 50. | *Mystus seenghala* (Sykes) | ... | Singalu. |
| 51. | *Mystus malabaricus* (Jerdon) | ... | Shingti. |
| 52. | *Mystus aor* (Ham.) | ... | Singalu. |
| 53. | *Rita hastata* (Val.) | ... | Kurdu. |
| 54. | *Rita pavimentata* (Val.) | ... | Ghoghrya. |
| | Family : SISORIDAE. | | |
| 55. | *Bagarius bagarius* (Ham.) | ... | Khirit. |
| 56. | *Gagata itchkeea* (Sykes) | ... | Itchka. |
| 57. | *Glyptothorax lonah* (Sykes). | ... | Phattachittu. |
| 58. | *Glyptothorax annandalei* (Hora) | ... | Phattarchatu. |

* Exotic fish introduced in Kolhapur waters.

| No. | Scientific names. | Local Marathi names. |
|---|---|---|
| | Family : SCHILBEIDAE. | |
| 59. | *Proeutropicthys taakree* (Sykes) ... | Munvi, Vyadi. |
| 60. | *Neotropius khavalchor* Kulkarni ... | Khavalchor. |
| 61. | *Pseudotropius atherinoides* (Bl.) ... | Sura. |
| | Order : CYPRINODONTES.<br>Family : CYPRINODONTIDAE. | |
| 62. | *Aplochilus lineatus* (C. & V.) ... | ... |
| | Order : SYNENTOGNATHI.<br>Family : XENENTODONTIDAE. | |
| 63. | *Xenentodon cancila* ... | Tokali. |
| | Order : LABYRINTHICI.<br>Family : OPHICEPHALIDAE. | |
| 64. | *Chana gachua* (Ham.) ... | Dokrya. |
| 65. | *Chana leucopunctatus* (Sykes) ... | Kalamasa, Murrel. |
| 66. | *Chana marulius* (Ham.) ... | Kalamasa, Murrel. |
| 67. | *Chana striatus* (Bl.) ... | Mhangsha. |
| 68. | **Osphronemus goramy* (Lacep.) ... | ... |
| | Order : PERCOMORPHI.<br>Family : AMBASSIDAE. | |
| 69. | *Ambassis ranga* (Ham.) ... | Kachki, Chembardi. |
| 70. | *Ambassis nama* (Ham.) ... | Kachki, Chembardi. |
| | Order : GOBIOIDEA.<br>Family : GOBIIDAE. | |
| 71. | *Glossogobius giuris* (Ham.) ... | Kharpya. |

* Exotic fish introduced in Kolhapur waters.

## SYSTEMATIC ACCOUNT

### **Chela clupeoides** (Bloch)

In his account of *Chela clupeoides* Day has stated that as a rule the number of rays in the anal fin vary from 13-15 (2/11-13) but in the specimens from Deccan he found them to be 2/13-15. In the specimens collected at Kolhapur the number of rays in the anal fin is 17.

*Colour*—Day in his account has described the coloration as silvery but has not mentioned about a distinct row, sometimes two rows, of about 8-10 black dots on each side as found in the specimens collected at Kolhapur.

*Size*—Day has stated that this species attains at least six inches in length. The largest size of *C. clupeoides* found at Kolhapur measured 9.5″.

### **Brachy-danio rerio** (Ham.)

In the specimens of *Brachy-danio rerio* collected at Kolhapur, dorsal does not commence opposite the anal as described by Day but it is slightly anterior to anal. Number of rays in the anal fin of the aforesaid specimens is 13-14 (2-3/11) instead of 15 to 16 as described by Day.

### **Balitora shimogensis** Silas & Kalawar

This new species of Homalopterid fish is discovered by E. G. Silas and A. G. Kalawar almost simultaneously near Shimoga in Mysore State and near Kolhapur in Bombay State. The diagnostic characters and other details about the fish will be published elsewhere.

Occurrence of this fish in Kolhapur and its zoo-geographical significance have been recorded (Kulkarni 1951).

### **Barbus fraseri** Hora & Misra

D. 2/8; P. 12; V. 9; A. 3/5; C. 19; L. 1. 43-47.

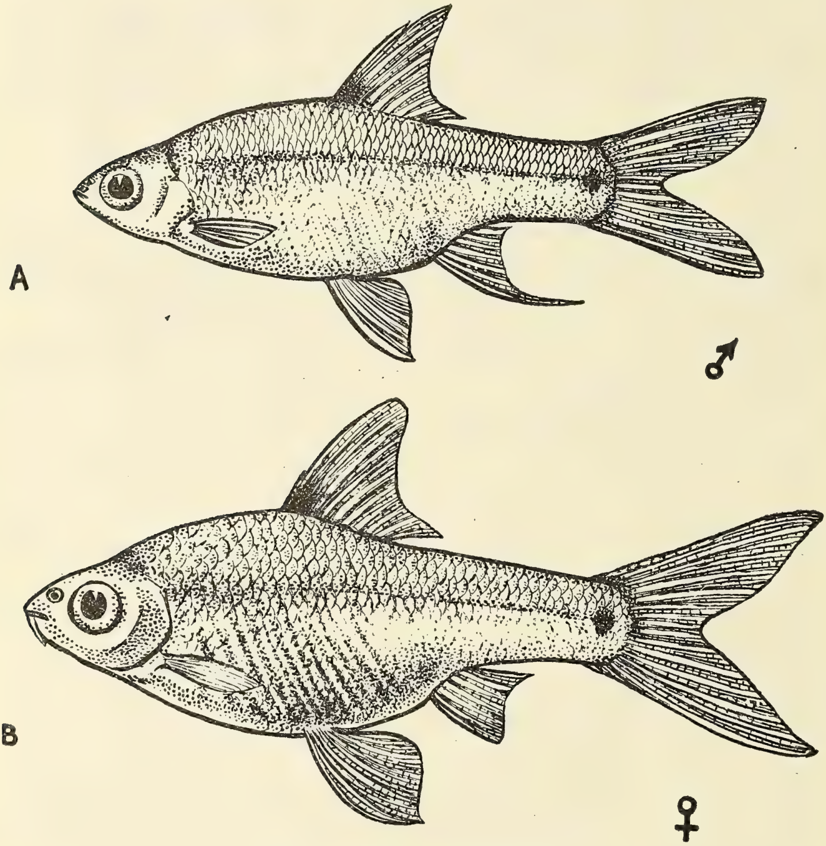
This fish was described as a new species from Deolali, Nasik District, by Hora and Misra when they commented on the collection made by Dr. Fraser. The description was based only on very few specimens and that too of only females. As males were collected for the first time only in the present collection, it is considered desirable to furnish a brief description of the fish.

This species of *Barbus* has a graceful form with a slightly compressed body and its dorsal profile slightly more convex than the ventral. Abdomen is rounded. Head is small and somewhat depressed. Mouth is small, crescentic, opening forwards inferiorly. Lips are fleshy and continuous at the angle of the mouth. Length of the head is 5.2 in total length and 3.9 in standard length. Height of the body is 3.5 to 4.1 in total length. Inter-orbital space is slightly convex and smooth.

The eyes are prominent and without adipose lids. They are situated on the lateral margin of the head so that half of diameter can be seen in the dorsal aspect and the other half in the ventral aspect. Eyes are situated nearer the snout in the length of the head. Their diameter is contained three times in the length of the head, $\frac{3}{4}$ times in the length of the snout, and is almost equal to the inter-orbital space.

There are two short maxillary barbels situated at the angle of the mouth. Lateral line is incomplete and extends to about 6-9 scales. There are 42-47 scales along the lateral line and 7-8 rows of scales between it and the base of the ventral fin. There are 14 series of scales between the base of the dorsal and ventral fin.

Origin of the dorsal fin is almost opposite the ventral, commencing midway between the tip of the snout and the base of the caudal fin. The upper edge of the dorsal is concave and its last undivided ray is osseous and serrated. Dorsal is slightly longer than the head and considerably shorter than the depth of the body. In the case of the male, the last undivided ray of the anal fin is much elongated, while in the female no such elongation of ray is marked.



A. *Barbus fraseri* (male)
B. *Barbus fraseri* (female)

Colour of the body is yellowish olive with a silvery streak on the sides. A faint golden spot is present on the occiput which turns brownish in preserved specimens. A small black spot is present at the base of the commencement of the dorsal fin and another black spot at the base of the caudal.

The female specimens closely resemble *Barbus fraseri* (Hora & Misra 1938). No reference was made to the distinguishing characters of the male. We have found that the adult males of *Barbus fraseri* have an elongated anal fin and they are smaller in size as compared with the females of the species. This sexual dimorphism may be regarded as a character to distinguish the sexes. The secondary sexual difference noted above can be made out clearly from a comparison of the drawings of male and female specimens here reproduced.

MEASUREMENTS IN MILLIMETRES

| | Sp. 1 ♀ | Sp. 2 ♀ | Sp. 3 ♂ |
|---|---|---|---|
| Total length ... | 46·0 | 45·0 | 41·0 |
| Length of the head ... | 9·0 | 8·5 | 8·0 |
| Height of the body ... | 13·0 | 11·0 | 10·0 |
| Diameter of the eye ... | 3·0 | 3·0 | 2·5 |
| Length of the caudal ... | 11·5 | 11·0 | 10·0 |
| Height of the dorsal ... | 10·0 | 9·0 | 9·0 |
| Length of the pectoral ... | 8·0 | 7·0 | 6·0 |
| Length of anal ... | 5·5 | 5·0 | 8·0 |
| Length of ventral ... | 6·5 | 5·5 | 6·0 |
| Inter-orbital width ... | 3·5 | 3·0 | 3·0 |

### **Botia striata** var. **kolhapurensis** nov.

D. 2/9; P. 2/9-10; V. 1/7; A. 2/5; C. 19.

The body is somewhat compressed laterally and the dorsal profile in front of the dorsal fin is a broad incline, which becomes an abrupt descent from the nostrils to the tip of the snout. The depth of the body is contained 3½ to 3¾ times in standard length and 4½ to 4¾ times in total length. The depth of the body is almost equal or slightly greater than the length of the head. The length of the head is contained 3¾ times in standard length and 4¾ times in total length. The head is greatly compressed and its length is nearly equal to the distance between the tip of the snout and the anterior root of the pectoral fin. Width of the head is more than half its own depth but almost half the length of the head. The eyes are of moderate size and their diameter is contained about 4 to 4¼ times in length of the head. Diameter of the eye is almost equal or slightly less than the length of the suborbital spines. The spine is bifid at the base. Barbels 8, subequal, the mandibular being the shortest pair. The mouth is crescentic when shut and is an oval aperture when open. The distance between the angles of the mouth when wide opened is equal to the diameter of the orbit. The upper lip overhangs the lower and both are somewhat thick and suctorial.

The dorsal fin arises in front of the origin of the ventral and both are situated nearer the caudal than the tip of the snout. The height of the dorsal fin is slightly greater than the length of the anal and ventral fins respectively. The ventrals are shorter than the anal. The anal possess two simple and five branched rays. The length of the pectoral is more than twice the suborbital spine and is much longer than the snout. The margin of the dorsal fin is entire and that of the caudal is deeply forked. The caudal lobes are of equal length.

The anterior of nostrils is surrounded by a very large glandular fold which covers the posterior nares. The opening of the latter is a wide funnel and that of the former a slit marked by glandular lips of the fold. The lateral line is entire and straight and terminates anteriorly in the upper corner of the gill opening. The scales are absent on the head, operculum and chest. They are small and nondeciduous.

The body is diversified by broad dark brownish green and narrow yellow bands which from behind the nape form slightly oblique hoops directed backwards. These bands do not completely surround the body. The bands fade into the ground colour as they reach the ventral surface. The ground colour is light yellowish. The broad dark bands bear light streaks of variable number forming incomplete hoops. The primary types of dark and yellow bands are broader on the sides of the head and are directed obliquely forwards. The primary yellow bands on the body are broad at the base and become narrow as they reach the dorsal surface. On the upper surface of the head, the dark and yellow streaks form a trident mark. The fins are pale and barred, the caudal bears two entire and one or two interrupted stripes.

The specimens closely resemble *Botia striata* (Rao) but differ from it on the points mentioned below.

| | *B. striata* (*kolhapurensis*) | *B. striata* (Rao) |
|---|---|---|
| 1. Maximum size of the fish ... | 57 mm. | 95 mm. |
| 2. Pectoral fin ... | 11-12 | 13-14 |
| 3. Body profile ... | Abrupt descent from the nostrils | Abrupt descent from the eyes |
| 4. Depth of body in standard length ... | 3½ to 3¾ times | 3⅓ times |
| 5. Width of the head to depth of the head ... | Width of the head is more than half of its own depth | Width of the head is just half of its own depth |
| 6. Diameter of eye in length of the head ... | 4 to 4¼ times | 5 times |
| 7. The bands on the body ... | The bands do not surround the body. | The bands completely surround the body. |

The main point of difference between *Botia striata* (Rao) and *Botia striata* (*kolhapurensis*) found at Kolhapur is in the size. From the collection of about 6750 specimens of *B. striata* (*kolhapurensis*) at different times of the year, the maximum size of the fish recorded is 57 mm. whereas *Botia striata* (Rao) is said to grow more than 90 mm. In view of this sharp difference, we are inclined to regard this as a new variety of *Botia striata*.

### **Aplocheilus lineatus** (Cuv. & Val.)

D. 8-9; P. 15; A. 17-19; L. l. 34. 36; L. tr.9.

The specimens of *Aplocheilus lineatus* at Kolhapur are more slender than those described by Day. Even in fresh specimens the proportion of height to the total length was 1:6 while Day has stated it to be

$1:5—5\frac{1}{4}$. Slight variation is also found in the number of anal rays and scales in the lateral line. Presence of a distinct black spot at the base in the middle of the dorsal fin as found in the specimens collected at Kolhapur has not been mentioned by Day in his description of *A. lineatus*.

Day states that fishes belonging to the genus *Aplocheilus* are mostly found in the neighbourhood of the sea or tidal river. It is, therefore, interesting to find the aforesaid specimen in the river Bhogavati near Radhanagari at an altitude of about 2,250 ft. above sea level. Similar observations on the occurrence of *A. lineatus* at high altitudes were made in Madras State (Chacko & Ganapati 1949).

## ACKNOWLEDGEMENT

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# OBITUARY

## MAJOR S. F. HOPWOOD, M.C.

*(late Indian Forest Service)*

Stephen Francis Hopwood, who died in February 1956 at his home in Louth, Lincolnshire, at the age of 75, was for many years a member of our Society, and very well-known among naturalists, sportsmen and forest officers in Burma. He joined the Indian Forest Service in 1903 and became Chief Conservator of Burma from 1930 to 1935.

Remarkably well read and acutely observant, with keen sense of humour, it seems a thousand pities to those of us who knew him that 'Hoppy' never wrote a book about his experiences, for few would be better worth reading. He fought with gallantry in France as a gunner-officer in the 1st Division in the Kaiser's War, and did good work as an intelligence officer on the Salween and later at G.H.Q. India in Hitler's War. When well over 60, he volunteered to re-enter Burma with the 'Chindits', after a most gruelling march out of the country in 1942, which took him 25 days and in which he lost everything he possessed.

Though not a scientific naturalist, Stephen Hopwood was passionately fond of big game shooting and mahseer fishing, and made many original observations on the fauna of Burma, too few of which got into print. He wrote a careful paper on the abundance of tigers in Burma in the *Empire Forestry Journal,* and shot a remarkable number himself in the Chindwin and elsewhere. He accompanied Arthur Vernay's first Burmese expedition from Moulmein across the Taok plateau in 1923, and with him sponsored and led the Vernay-Hopwood expedition in 1935 from Nanyaseik across to the falls of the Chindwin, a trip on which R. C. Morris and Charles McCann made many notable discoveries. Hopwood probably knew more of the Burmese forests from the Hukawng to Tenasserim than any previous Conservator and, after retirement, became an expert on the tung oil plant in the Shan State.

All who ever travelled with him will mourn the death of a delightful and talented companion, who was interested in wild life of every kind.

J. K. STANFORD

# REVIEWS

## 1. BOTANICAL COLLECTOR'S MANUAL.

By H. Santapau, S.J., F.N.I. Pp. v+62 ($6\frac{5}{8}'' \times 4\frac{3}{4}''$). 13 text-figures. Ministry of Natural Resources and Scientific Research, Government of India, New Delhi, 1955. Price not indicated. (Re. 1-2-0).

This useful publication by the well-known botanist, Rev. Fr. H. Santapau, S.J., aims at standardising the various methods employed in the collection and preservation of specimens of flowering plants so that every Indian botanist would follow a more uniform system and facilitate comparison of results.

The first chapter deals with the instruments needed for field and herbarium work and is suitably illustrated.

The second describes the methods of collecting specimens and their immediate preservation in the field. What should be collected, how much should be collected, and the necessity and importance of maintaining field-books for recording ecological and other interesting notes of specimens, as also the use of labels indicating accurate data in each case, are lucidly discussed.

The processing of plants for the herbarium, the mounting of herbarium specimens, and their preservation and handling form the subject matter of the three succeeding chapters. Profuse illustrations, significantly instructive to herbarium-keepers, highlight these chapters. A list of reference books to be always kept handy in the herbarium is also furnished.

The print is bold and clear, though the get-up of the booklet could have been made a little more attractive.

The Ministry of Natural Resources and Scientific Research deserves to be congratulated on having secured the good offices of such an experienced botanist in bringing out this compact vade-mecum. All botanical collectors and students of botany of the upper University classes will welcome the appearance of this handy guide.

V.K.C.

## 2. SOME EXTINCT ELEPHANTS, THEIR RELATIVES AND THE TWO LIVING SPECIES.

By P. E. P. Deraniyagala. Pp. 161 ($11'' \times 8\frac{1}{2}''$). 48 black-and-white plates. Ceylon National Museums Publication, August 1955. Price ?

This interesting volume by P. E. P. Deraniyagala, Director of National Museums, Ceylon, is the result of study extending over a quarter of a century. It encompasses not only a morphological and systematic account of the extinct elephants of Africa and SE. Asia, but also of the habits, food, diseases of the living forms. It is in short a comprehensive study of the Proboscidean fauna of these regions, dealing with as many as 43 species and subspecies. The author's own contribution to Proboscidean systematics is one order, two subfamilies, and one genus besides a number of species and subspecies.

The author deals briefly with the evolution and classification of Proboscidea and stresses the need for further subdivision into subgenera and even subfamilies on the basis of calva. It is, however, doubtful if all authorities will agree with the basis of his classification. Nevertheless, his point of view is of fundamental interest.

In the last part of the book the author has included three appendices. Of particular interest here is the ancient Indian treatise the *Gaja Sastra,* in which the elephants are classified and other useful details regarding their diseases and medicines required for their cure, etc. are given. The author is to be congratulated on his effort in producing such a valuable and useful publication.

M. R. SAHNI

3. TREE TOPS. By Jim Corbett. With an introduction by Lord Hailey. Illustrated by Raymond Sheppard. Pp. xxii + 30 ($7\frac{3}{4}'' \times 5''$). Oxford University Press, London 1955. 6 *sh.*

'In the course of a long lifetime, I have seen some courageous acts, but few to compare with what I witnessed on that fifth day of February.' In these terms Jim Corbett describes the arrival of Princess Elizabeth at Tree Tops, the hut on the *Ficus* tree in which she spent a few carefree hours watching life in the African jungle and from which next morning she descended as Queen of England. Faced with a herd of elephants at the salt lick, she unhesitatingly advanced to the foot of the ladder, within 10 yards of the elephants, and, making over her handbag and camera to the author, calmly mounted the steps to Tree Tops. In the few hours that followed the African jungle did its best to entertain the royal visitor, and lovers of nature will be glad to share the thrills that she experienced. The author tells the tale with the skill which his previous books have taught us to expect, and we lay down the book with regret that it is not longer.

The interest is not merely incidental, for the author tells us something of the family life of the African elephant, and gives us glimpses into the minds of wild animals and their social relationships with each other. An elephant blew dust at some doves for fun and 'flicked its trunk up and down as if laughing and flapped its ears with delight', and a young doe bushbuck provided a game for a baby baboon and seemed to enjoy it. Two rhinos, evidently old enemies, manoeuvred for position and abandoned the combat, while two waterbucks enacted the last stage of their contest and the dead loser was carried off by some beast of prey even as the royal party watched.

The book was written shortly before the death of Jim Corbett in his eightieth year.

The introduction giving an all too-short sketch of the modest author is very welcome. So are the well-executed marginal drawings which illustrate the text.

D.E.R.

4. ACTA XI CONGRESSUS INTERNATIONALIS ORNITHOLOGICI. (Proceedings of the XIth International Ornithological Congress). Edited by Adolf Portmann & Ernst Sutter. Pp. 680 (*ca.* 9½″ × 6½″). 12 photographic plates, numerous text-figures and diagrams. Basel-Stuttgart (Birkhäuser Verlag), 1955. Price 36.40 Swiss francs.

The XIth International Ornithological Congress was held at Basel, Switzerland, from 29 May to 5 June 1954 with Sir A. Landsborough Thomson as President and Prof. Dr. Adolf Portmann as General Secretary. Over 600 persons from some 40 countries participated, including official and semi-official delegations from 32, and most of the leading ornithologists of our time. This volume which is the official record of the session, in addition to giving an account of its activities, and of the excursions preceding and following the formal sittings, contains the complete text of all the papers read or presented at it, and is in effect an authoritative review of the advances and trends in modern ornithological science. The papers received by special invitation from persons distinguished in their particular spheres of work are of exceptional interest and value.

The contents are divided into the following sections: I. General Lectures (7 papers), II. Symposium on Visible Migration (8 papers), III. Hearing and Analysis of Voice (3 papers), IV. The Biology of Penguins of the Antarctic (5 papers), V. Morphology and Palaeontology (8 papers), VI. Systematics and Speciation (14 papers), VII. Zoogeography and Faunistics (8 papers), VIII. Ecology and Population (26 papers), IX. Life History and Behaviour (24 papers), X. Migration (12 papers), XI. Folklore (1 paper).

The presidential address on 'The Place of Ornithology in Biological Science' is a masterly survey and is, in effect, an index of the general contents of the volume. This is followed in the Section of General Lectures by Dr. A. I. Ivanov's informative account of 'Ornithology in the U.S.S.R. in the post-war period'. Sections IV and IX contain some superb photographs, superbly reproduced, of penguins and woodpeckers, the latter feeding young within their nest-holes, obtained by ingenious techniques employing infra-red rays.

The volume, which is handsomely printed, thus covers all the most important aspects of, and developments in, modern ornithology particularly during the 4-year period since the 1950 Congress in Sweden.

As must be expected from such a large and heterogeneous collection, the papers are rather variable in quality. In general, however, the papers and particularly, the major contributions are truly admirable, and they serve to indicate the very high standard of ingenuity, technique and scientific precision attained by present-day ornithological investigators. Moreover, the abundance of the papers offered in the sections on Ecology and Population Dynamics, and Life History and Behaviour are a refreshing pointer to where the accent lies in modern bird study.

I understand that copies of the Proceedings of the Uppsala Congress as well as those of its predecessor at Rouen, 1938, are still available, the former from Almquist & Wicksell, Booksellers, Uppsala (35 Swedish crowns), and the latter from the Museum d'Histoire Naturelle, Rue Beauvoisine, Rouen (1200 Fr. frcs.); also the special number of *L'Oiseau* 1938 (300 Fr. frcs.). The three volumes of 'Proceedings' between them provide an authentic and comprehensive review of the progress and trends in scientific bird study during the last two decades. They are indispensable as reference works in any ornithological library.

S.A.

5. A COLOURED ATLAS OF SOME VERTEBRATES FROM CEYLON, Vol. III. Serpentoid Reptilia By P. E. P. Deraniyagala. Pp. xii+49+6+121. Coloured plates 14+half-tone plates 7 with 23 illustrations + 37 text-figures. The Ceylon Government Press, 1955.

This is volume III of 'A Coloured Atlas of Some Vertebrates from Ceylon' dealing exclusively with the snakes of the Island and concluding the work on Reptilia—crocodiles, testudines and lizards have already been dealt with in Vol. II of this series (Tetrapod Reptilia) a review of which appeared in *JBNHS*, 52: 904. In all 83 species of snakes as against 60 listed in 'Snakes of Ceylon' by F. Wall (1921) are described in this volume of which 12 are marine. Most of the species are well-illustrated and Dr. Deraniyagala's talent as an artist is in evidence right through.

The text is accurate and follows the latest classification, synonymy and nomenclature, definitions and limits of Orders, Suborders, Families, Subfamilies and Genera having been revised in the light of new knowledge.

Simple keys are furnished to facilitate easy identification. The text-figures of several species are grouped together to enable easy comparison.

A systematic index preceding the text and 4 different indexes to scientific names, English names, Sinhala names and Tamil names, together with a bibliography at the end, make this an ideal reference work.

Sinhala Serpent Lore extracted from 'The Sarapaduteya Nohoth Sarapothpaththiya'—an ancient Palm Leaf manuscript—is the subject matter for Appendix I, while 'Snake Bites and their Treatment' is the subject of Appendix II wherein a very useful account is given in simple and non-technical language. Appendix III is devoted to the services rendered by Dr. John Davy (1790-1868) to the Island in his 'An Account of the Interior of Ceylon and its Inhabitants, with Travels in that Island' (1821), in which chapter 4 is exclusively on snakes of the Island.

The coloured illustrations appear to deviate slightly from the natural colours of the species depicted. The print is clear and the get-up satisfactory. Dr. Deraniyagala is to be congratulated on his having produced this excellent series, and every library should make room for the addition of these volumes. No herpetologist should miss this one.

Other volumes in this series are awaited with interest.

V.K.C.

6. TRAVELS AND TRADITIONS OF WATERFOWL. By H. Albert Hochbaum. Pp. 301 (10″ × 7″). With numerous line drawings, maps and figures in the text. Minneapolis (The University of Minnesota Press), 1955. Price $5.

The mysteries connected with the migrations of birds continue to be attacked on all fronts and from all angles. Many of them have yielded before the determined onslaught of cleverly devised and co-ordinated techniques. Others have been battered so heavily that chinks are already beginning to let the light through; yet others remain invulnerable and unrelenting, but there is no doubt that the perseverance and ingenuity of investigators, and the application of new strategies will ultimately bring capitulation up to the point which is humanly attainable—for clearly there is a limit.

On the many fronts that have been assailed, it has been left to Dr. Hochbaum to emphasize the importance of Tradition as a factor in enabling migratory birds to orientate themselves correctly on their journeys between their breeding grounds and their wintering ranges. As Director of the celebrated Delta Waterfowl Research Station on Lake Manitoba (Canada), the author has been able to pursue his observations and study of the problem over a long period of years. The concept is, in principle, an extension of what should be common knowledge to all observant sportsmen, that duck will flight from one corner of their feeding grounds to another over a certain set route year after year, which is not necessarily the shortest or most direct approach. Shooting butts positioned after a careful study of the pattern of local travel by the birds continue to be productive year after year, despite the fact that the configuration of the marsh may have altered considerably in the interval, so that the route followed no longer provides the advantage to the birds it may originally have done.

The general burden of the book is that, while the act of migration may be inherent, the geographical world in which it takes place is learned by experience. In other words the route of migration, once established by successful pioneers, is handed down through tradition —young birds travelling in company with experienced adults on their first autumnal migration and returning with them to their natal breeding grounds in spring passing down the knowledge of routes and landmarks from generation to generation.

Dr. Hochbaum is cautious to mention that 'throughout the book waterfowl refers to N. American ducks, geese and swans of the family Anatidae', but it seems reasonable enough to suppose that this tradition concept applies in varying degree to other parts of the world and to other groups of birds as well.

Subjects such as The Function of Memory, The Aerial Environment, Awareness of Time and Space, Influence of Bad Weather, Overseas Migration, Awareness of Direction, and others, are discussed in a lucid and fascinating manner, fully confirming the reputation as a waterfowl researcher and writer which the author established for himself by his classical study 'The Canvasback on a Prairie Marsh' a few years previously (1944).

It has been found that a female duck is faithful to her breeding place as long as that area remains favourable for nesting. The drake on the other hand is liable to pair up in his winter quarters with a female from an entirely different breeding population and to be carried away elsewhere in her company on the spring migration. Thus, in ducks which take new mates each year, the destination of the drake depends upon the traditional experience of the female.

Just as old traditions may be broken by the disappearance of experienced individuals who form the vital link in their continuity, so can fresh ones be built up by successful pioneers. Where artificial transplanting and establishment of such pioneers can be achieved, it is possible, for instance, to rehabilitate species and populations in areas whence they have disappeared through direct human persecution.

Recent studies in bird behaviour, especially of the Anatidae, have shown that the phenomenon of 'imprinting' plays a vital role in this group. Ducklings and goslings, hatched in an incubator and hand-reared, get so firmly 'imprinted' with their environment and keeper that they will follow the latter about and behave with him exactly as they would with their natural parent. Utilizing this knowledge, a technique has been developed for restoring breeding populations of various species of ducks and geese to areas where they have become depleted. Hand-reared young birds are released on these marshes at 5 to 7 weeks age, before they are able to fly. The females get the environment 'imprinted' on them and, being faithful to their home grounds, they return here in spring bringing with them the mates they have acquired in the wintering area to augment the breeding population. This is a technique which could possibly prove of practical usefulness in India in our proposed rehabilitation of the Whitewinged Wood Duck in areas of Assam where the original populations have been 'burned out'. Unfortunately, however, we do not as yet possess the requisite research organization or facilities to undertake such experiments. Until a proper wild life research organization is established, all our efforts in wild life preservation must either remain largely academical, or be carried out by purely empirical hit-or-miss methods, which are seldom the most economical or effective.

The book is a highly readable and stimulating contribution to waterfowl migration and behaviour literature, and the author's excellent line illustrations in the text add greatly to its appeal.

S.A.

# MISCELLANEOUS NOTES

## 1. DISTRIBUTION OF THE LIONTAILED MONKEY, *MACACA SILENUS* (LINNAEUS)

Blanford in the old Fauna (1891) gives the distribution of this species as 'the forests of Sahyadri range or Western Ghats from about 14 degrees North to Cape Comorin'. Pocock in the Fauna of British India, 2nd ed.—Mammalia Vol. 1, page 69 (1939) refers to Baker's record [*JASB*, xxviii, p. 283 (not page 238)] of its occurring in the Western Ghats as far north as Goa. His own distribution (p. 66) reads 'SW. India, the Western Ghats, principally of Travancore and Cochin, but *alleged* to occur from about 14 degrees N. lat. to Cape Comorin.' Prater in The Book of Indian Animals gives 'Western Ghats from Kanara southwards to Travancore and Cochin'. Ellerman and Scott also state that the approximate distribution of this species is 'Peninsular India, the Western Ghats principally of Travancore and Cochin'.

It may therefore be worth recording that R. S. Dharmakumarsinhji, Wild Life Preservation Officer, Bombay State, saw one in N. Kanara on the Anshi Ghat (alt. 1,000 ft.), between Kadra and Kumbharwada, on 20 December 1955-*ca.* 15° N. lat. This locality may now be pin-pointed for the northernmost record.

Bombay Natural History Society,
114, Apollo Street,
Fort, Bombay,
*March* 2, 1956.

EDITORS

## 2. LONGEVITY IN THE CEYLON RUDDY MONGOOSE *HERPESTES SMITHII ZEYLANIUS* THOMAS[1]

Phillips's (1954) record of the duration of life in captivity of a Ceylon Ruddy Mongoose (*Herpestes smithii zeylanius*) in view of the reported inadaptability (compared with other mongooses) of this species to confinement prompts me to publish the undermentioned data. The circumstances suggest at least an equal longevity with Phillips's example and may exceed it.

In April 1931 I was presented with a fully adult but delightfully tame female Ruddy Mongoose. She lived in my private collection in Colombo until December 1944 when she was deposited in the Zoological Gardens, Dehiwela, pending transfer to the Regent's Park menagerie of the Zoological Society of London, which she eventually reached in July 1946. She died there on 19 June 1947, apparently not from organic disease, the only abnormal condition found at death being slight osteomalacia.

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[1] Published with the permission of the Zoological Society of London.

This gives a duration in captivity of at least 16 years 2 months compared with Phillips's record of 16 years 9 months as the full age of his example at the time of his report. But Phillips's animal was only 3 months old when captured as against mine being fully adult and sexually mature when first seen. Unfortunately I have no information of the previous history of my specimen, beyond its having been in captivity 'for some time'. In view of the known duration of life of the larger carnivores, the age of 16 years in any mongoose is remarkable, but must surely approximate to the potential limit, though the absence of obvious signs of senility at autopsy does not support this. The osteomalacia *may* be a senile condition, but dietetic inadequacy during war-time seems a more likely explanation in the absence of other senile changes.

Although at least nine other mongooses of several species were kept in my collection from time to time, no other survived so long.

It is to be hoped that a record will be kept of the particulars and fate of the example mentioned in Phillips's note.

THE ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK,
LONDON, N.W. 8,
*May* 8, 1956.

W. C. OSMAN HILL,
M.D., F.R.S.E.

REFERENCE

Phillips, W. W. A. (1954): Longevity in the Ceylon Ruddy Mongoose (*Herpestes smithii zeylanius*). *JBNHS*, **52**: 587.

[By a strange coincidence, the above communication arrived just when Mr. Phillips's second note was in the final stage of printing (Vol. 53: 468). In it he records the death of his mongoose at the age of approximately 17 years and 11 months.—EDS.]

## 3. STRANGE BEHAVIOUR OF BATS

We were collecting bats (*Rhinopoma kinneari* Wroughton, *Rhinopoma hardwickei hardwickei* Gray and *Taphozous longimanus longimanus* Hardwicke) from a large cave at Barmer in November 1955 at about 11.30 a.m. with the help of butterfly nets. The animals were transferred to small cages, which were brought outside the cave. After a few minutes we saw about twenty *R. kinneari* swarming around us. They settled on a nearby rock and began squeaking loudly towards the cages. Thereafter some of them actually clung on to our cages containing the bats. They were forced to fly away, but to our surprise five more came down from the rock and clung to the cage, and some others to our bush-coats. The bats were again driven away from the cages, but another set of bats soon replaced them. Only after all the cages had been wrapped up in cloth did their 'attacks' cease.

As is well known, if a cave is entered and the bats disturbed, most of them will fly out, but soon return. It was the returning bats that reacted to their captured companions in this manner.

DEPT. OF ZOOLOGY,
MAHARAJA'S COLLEGE, JAIPUR, ISHWAR PRAKASH
JASWANT COLLEGE, JODHPUR,
*March* 10, 1956. S. C. SHARMA

## 4. RATS IN HUMAN DIETARY

We were camping in the jungles of West Khandesh Division and, while returning one cold evening in January around sunset in a bullock cart from the banks of the river Tapti after an unsuccessful Mugger hunt, my companion, a forest officer, and I espied a cheerful fire crackling in a nullah about 50 yards from the fire-line along which we were travelling. Hoping to catch some poachers redhanded with their illicit gains, my companion and I tip-toed to the spot to find an old man and a couple of young lads sitting comfortably by the fire and calmly chewing the cud of thought. Near the fire lay one large basket covered over with fresh green leaves.

They evinced no great surprise when thus we broke in on their tranquillity. However, when asked to open up the basket, they demurred. Our suspicions strengthening, we repeated that they should uncover the basket promptly, whereupon the old man did so and what a loathsome sight greeted our unbelieving eyes! The basket contained nothing but dead rats of varying sizes; big rats, small rats, middling rats, even small little squeakers, all together numbering about 50 and all recently singed over a fire without even the trouble of having their intestines removed. There they lay, as if living in death, with bloated stomachs and glazed eyes, their greyish white skin shining smooth under the fire light as all the hair had been scraped carefully away. It was enough to rob us completely of our keen appetite for dinner.

This party, who belonged to the Kathodi Bhil tribe, averred that rats were a frequent item of diet on their otherwise meagre menu. However, when asked to eat one in our presence, they declined. Then, they went on to explain to us the 'modus operandi' of rat-catching. When they come across what looks like a promising rat-hole, they dig deep and wide around it, widening its mouth. Then a piece of rag soaked in a little kerosene is lighted up and put therein, and a basket lined with green leaves is used as a cover on top. This causes the smoke to go underground in the winding tunnels and the rats, on getting the smoke or smelling something afire, make for the nearest exit. But men are already posted there and on the rats emerging finish them off with their sticks. If any agile rodent eludes the men with sticks, then it meets its fate at the hands or rather the canines of their pet mongrel, and we saw several such rats which bore on their bodies the marks of canine teeth. Sometimes, these men use the expedient of flooding out the rats, if a source of water like a nullah or river is handy.

However, with these men also there was a point of honour. When we suggested that they carry out their operations in adjoining fields where rats were reportedly doing a lot of damage, they shook their heads emphatically. Jungle rats only would be acceptable. Field rats were not their kettle of fish.

Thinking this incident over on the way home I felt that, after all, a meal of cooked rats is really not so revolting. The jungle rat is comparatively a clean feeder and belongs to the same group as the rabbit whose meat most of us will tuck away with much evident relish.

BANOO MANSION,
NANPURA, SURAT, F. D. GHEYARA
*February* 13, 1956.

[The species referred to is apparently the Indian Mole-Rat (*Nesokia indica*), a prolific and destructive species with practically an all-India distribution. It forms a regular item of food for many local tribes in the countryside, who, in addition, dig up its burrows after the harvest for the grain it is in the habit of storing away. According to Jerdon a single burrow will sometimes yield as much as half a seer (1 lb.) of grain, containing even whole ears of jowari (*Sorghum vulgare*).—EDS.]

## 5. TUSKS OF INDIAN ELEPHANTS

Further to my note of 15 October 1946 (*JBNHS*, 46: 717/18), on the question of size of Indian elephants and their tusks, I send you details of two pairs of tusks which are still bigger than the ones I reported.

In 1953 the Ruler of Talcher killed a rogue tusker elephant in Dhenkanal, Orissa, which was 11′ in height, each tusk weighing 1 md. 10 seers and measuring 8′ 6″ in length. A photograph of the Raja with the tusks was published in the *Amrita Bazar Patrika* of 15 February 1953.

In 1952 a very large pair of tusks was found in the Goalpara East Division, Assam, the elephant having died a natural death or having been shot by poachers. One tusk weighed 1 md. 9 seers. 13 chattaks and measured 9′ 2″ in length and 1′ 5″ in girth. The other tusk was found cut short, probably by the persons who had concealed both the tusks in the jungle with the obvious intention of stealing them. Though some cut pieces were recovered, it was not possible to ascertain the exact measurements and weight of the mutilated tusk. As the two tusks were obviously symmetrical it may be taken that the cut tusk was of approximately the same length, weight, and girth as the complete tusk. The cut tusk was re-constructed with a wooden piece shaped and coloured exactly like the ivory and the pair was exhibited at the IVth World Forestry Congress at Dehra Dun in December 1954.

While the Ruler of Talcher's pair is the second heaviest *pair* on record, there are 3 individual tusks on record each heavier than a single tusk of this pair. The uncut tusk of the Assam pair referred to here is the third longest on record. I give below the weights and measurements of some of the biggest tusks as far as I have been able to ascertain:

| No. | Length outside curve | Greatest circumference | Weight | Locality | Owner |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| 1. | 9′ 2″<br>—Do— (?) | 17″<br>—Do— (?) | 1 md. 9 Srs. 13 ch. (91 lb. 13 ch.)<br>—Do— (?) | Assam, Goalpara East, 1952. | Assam Forest Museum, Gauhati. |
| 2. | 8′ 6″<br>8′ 6″ | —?—<br>—?— | 1 md. 10 Srs. (92 lb.)<br>1 md. 10 Srs. (92 lb.) | Orissa, Dhenkanal, 1953. | Ruler of Talcher. |
| 3. | 7′ 3⅜″<br>7′ 3¼″ | 17½″<br>17⅛″ | 102 lbs.*<br>97½ lb. | Burma (King Thebaw's sacred white elephant.) | * *Record.*<br>Marquis of Waterford. |
| 4. | — | — | 100 lb. | Assam. | The late Charles Redde. |
| 5. | 8′ | 16⅞″ | 90 lb. | S. India. | Sir Victor Brooke's Collection. |
| 6. | 8′ 0″<br>8′ 0″ | 16½″<br>16¾″ | 82 lb.<br>82 lb. 14 chs. | Assam, Goalpara West, 1946. | Assam Legislative Assembly, Shillong. |
| 7. | 7′ 8″ R.<br>7′ 10″ L. | 18⅝″<br>19¼″ | 79½ lb.<br>82½ lb. | Coimbatore Jungles, S. India, 1923. | C. R. T. Congreve (*JBNHS*, 29: 1045). |
| 8. | 8′ 9″. R.<br>8′ 2″. L. | 17¼″<br>... | 81 lb.<br>81.2 lb. | Assam. | Late Lord Lytton. |
| 9. | 7′ 5″ R.<br>7′ 4″ L. | 17¼″<br>17″ | 77 lb.<br>71 lb. | Mysore | Maharajah of Mysore. |
| 10. | 7′ 1½″<br>7′ 3″ | 18¾″<br>18½″ | 77 lb.<br>77 lb. | Assam, Goalpara West, 1940. | P. D. STRACEY, I.F.S. |
| 11. | 6′ 6″<br>5′ 8″ | 19″ *<br>16″ | 68 lb.<br>44 lb. | Mysore. | * *Record.*<br>Major Goring and C. Theobald. |
| 12. | 5′ 9″<br>5′ 11″ | 18½″<br>18½″ | 65 lb.<br>62 lb. | Wynaad, South India. | W. H. Pitt. |

1 md. = 82 lb.

F.R.I. & COLLEGES,
DEHRA DUN,
*April* 4, 1956.

P. D. STRACEY, I.F.S.

12

## 6. RHINOCEROS IN THE KACHIN STATE

'We are not told what people inhabited Lin-yang. Several early works, some dating from the 4th Century, refer, more or less fancifully, to the tribes living SW. of Yung-Ch'ang. In the mountains astride the Frontier there were the wild and troublesome P'u (b'uok) tribes, whose land produced rhinoceros, elephant, tortoise shell, jade, amber, cowries, gold, silver, salt-wells, cinnamon and cotton trees, hill-paddy and panicled millet.' Burma down to fall of Pagan, by G. H. Luce and Pe Maung Tin. *Journal Burma Research Society*—XXIX—1939 (page 267).

The country referred to in the preceding paragraph may be identified with the present Kachin State which lies in the north of Burma and comprises Myitkyina and Bhamo Districts.

In September 1955 the Ministry of the Kachin State conducted an enquiry in order to ascertain the species and number of rhinoceros still surviving within the State.

Putao Sub-division:

The Assistant Resident reported in December 1955 as follows:

(*a*) A villager reported having seen fresh tracks of two smaller rhinoceros in the Namlang stream.

(*b*) A large solitary rhino is also reported on the border of Putao Sub-division and Hukawng Valley.

The Assistant Resident cannot say whether the rhinoceros are the great one-horned or the Asiatic two-horned rhinoceros.

But in view of the fact that a rhinoceros shot by a Lisu in the Namlang Valley in 1942 was one-horned, and one previously shot also one-horned, the rhinoceros now reported from Putao Sub-division may be a great one-horned or Indian rhinoceros, which had wandered into the area from Tirap Frontier Tract National Park, Assam. Part of the boundary of this National Park is the Burma frontier.

They could not be the smaller one-horned or Javan Rhinoceros as E.H. Peacock in 'A Game Book for Burma', 1930, writes (page 78): 'It is open to question whether the Javan rhinoceros ever existed outside of the Thaton, Salween and Mergui Forest Divisions in Lower Burma. The only definite records of its existence come from these three Divisions.'

For a previous note see *JBNHS*, Vol. 52, No. 1, April 1954, page 87.

Kamaing Sub-Division:

The Assistant Resident, Kamaing, submitted in November 1955 a copy of a report dated October 1955 from the Kayang-Ok Hpakan (Kayang-Ok is a petty officer in charge of a circle, which comprises an average of six village tracts). The gist of the report is as follows:

(*a*) There are rhinos in Kan Taik Bum, Wantuk bum, Bum Chyang bum, Hpala mung bum, Bumdaw bum.

(*b*) The minimum estimated number is about thirty.

(*c*) In April 1955, Laisai Duwa came upon fresh rhino tracks between Laisai and Haung Pa which is on the Chindwin River. The size of the tracks was about the size of the track of an elephant measuring 6 to 7 ft. in height.

(*d*) In 1952 a villager from Ohn Done village shot a rhino. The locality where it was shot was not known. About the same year, the headman of Pa-ok-gyi village shot two rhinos in Bum Chyang bum.

(*e*) In March 1954 a villager from Lonkhin village who went in search of amber in the Laisai tract saw numerous fresh tracks of rhinoceros.

The writer has previously estimated the number of rhinos in the Laisai tracts as from 3 to 4 specimens. See *JBNHS*, Vol. 52, No. 1, April 1954, page 85.

The writer therefore enquired of the Assistant Resident, Kamaing, whether the number thirty as estimated by the Kayang-Ok was not high. The Assistant Resident replied in February 1956 that:

(1) the estimate is reasonable.
(2) the rhinos in the area are the Asiatic two-horned rhinoceros.
(3) a white rhino was shot in the area some thirty years ago.
(4) fresh tracks of rhino calves have not been reported, and
(5) the rhinoceros in the area are dangerous and 'from distance, when they see fire-smoke, they use to charge'.

The same belief is held by Karens. See an extract from Burma by Rev. F. Mason D.D., M.R.A.S., 1882 pp. 451-452:

> 'The Southern Karens say there is a third species of rhinoceros in the jungles, which is distinguished from both the others by its skin being covered with small tubercles, and above all by its eating fire. Wherever it sees fire it runs up and devours it immediately. I once lost my way among the hills and valleys of Palaw and Katay, and on obtaining a Karen, who lived in that region, for a guide, he laid special charge on every member of the party to follow him in silence, for a fire eating rhinoceros had been recently seen, and it always came to noises, instead of fleeing from them as most animals do.
>
> The habit of attacking a fire and trampling it out (the eating part of the performance being probably an embellishment) may have originated in the sagacity of the animal or to the mixed operation of fear and rage combined, as a savage dog will pursue and bite the stone thrown at it; and in time an act wholly unconnected with the natural economy of the animal, and developed by an accidental circumstance, may by the operation of the laws of heredity have become converted into an instinct. This idea receives some support from the behaviour of bees. When preparing to smoke off a swarm of bees from their comb in the jungle, especial care is taken by the Burmans not to allow the flame to rise, or to "crackle", as the bees are said to be at once roused to fury by the *sound* of the flames, and to attack every one within reach. Doubtless experience has taught them the danger to their home which attends a crackling fire in the wood, and they at once resort to the weapon of offence with which they are provided. A rhinoceros is actuated by

> precisely the same sentiment, and he rushes to the detested fire and tramples it beneath his feet as he would a living enemy.'

25, Inyamyaing Road,
University P.O.,
Rangoon,
Union of Burma,
*April* 12, 1956.

U TUN YIN,
B.C.S. (Retd.)

[This is not conclusive, as *R. sumatrensis* has usually only one horn in evidence, the anterior one. The posterior horn is usually a mere pimple, if that. So villagers would only notice one horn. The real criterion is size, the heavy folds in the tuberculated or 'studded' skin at the shoulder etc. The species of the rhino alleged to inhabit the Tirap Frontier Tract National Park (valley of the upper Dehing River) has never been determined, as only footprints have been seen in recent years. On the other hand, as *R. unicornis* has been seen in the nearer hills of the Tirap Frontier Division, two or three days march from Margherita, and in the Naga Hills east of Kohima, it is not impossible that it may also be found in north Burma. Thus when a rhino was seen two or three years ago in the Tirap Frontier Division, Mr. Gee sent up two pictures, one of a *R. unicornis* and one of a *R. sumatrensis*. These were shown to the man who saw the rhino, and he confirmed that it was the former. More investigation is worthwhile.—Eds.]

## 7. NATURE'S ECONOMY

In a recent publication by the International Union for the Protection of Nature entitled *Protect Tomorrow's World Today* my interest was aroused by two paragraphs which recalled incidents from the past. Para 10, p. 12 deals with the hippopotamus as a beneficial factor to fish and aquatic life in general in the rivers and lakes of Africa; and para 24, p. 26, condemns the goat as, perhaps, the most destructive animal on earth. Some comments in relation to these paragraphs and India might be of some interest to some of our readers.

Para 10 reads as follows:

'The relation between beings cannot always be seen: they are often linked in the most unexpected way. Who, for instance, would think of linking these hippopotami, that live part of their mysterious existence in African waters, with fish farming? But they are valuable auxiliaries. Especially in the case of East African Lakes that are fed a relatively small quantity of water by their tributaries, every plant and animal plays the role of a regulator. The excrements of the hippopotami fertilize the water depths, favouring the formation of phytoplankton which, for its part, nourishes the tilapais. These indigenous fish are widely used by the large fish farming enterprises and supplement the protein so essential to African peoples.'

The same line of interrelation between the Indian Buffalo (*Bubalus bubalis*), whether wild or domesticated, and the aquatic life of some Indian rivers and lakes could be interpreted in much the same way. The following incident may be of interest:

The late Dr. M. Suter, a keen fisherman, and I went together along the road between Kalyan and Murbad. Along this road, a few miles out of Kalyan, a bridge crosses a tributary of the Ulhas River. This point was the Doctor's main objective. On alighting from the car and peering over the parapet we could clearly see a fairly large number of large carp (Dobson's Carp ?) in the water below us, particularly around a herd of buffaloes 'cooling off' on the right-hand side of the bridge. The fish milled around the buffaloes in numbers. The carp were few on the left-hand side of the bridge (down stream). Dr. Suter was delighted at the prospect of a good catch. He 'flogged' the stream on the left of the bridge (away from the buffaloes) using every device and lure he had, without success. Eventually he decided that the hooks he was using were too large for this small-mouthed species, but a change brought no better results. Still determined, he decided to ply his art nearer and among the buffaloes, but nothing seemed to attract the fish away from the buffaloes in the river. Finally, he gave up in disgust. For a time we watched the proceeding and then moved off in quest of further natural history.

The reason for the fish not accepting the lures of the fisherman was too obvious, they were feeding on the excreta of the buffaloes. Some of the fish would follow the drifting masses of excreta down stream for a time, but would soon return to the source of supply. The constant 'nosing' of the fish around the anus of the buffaloes seemed to stimulate excretion.

Such chains of interrelation between animals, and animals and plants are perhaps commonplace in the animal world and the plant world—only Man tries to be 'self-contained' and 'self-sufficient' !

Para 24, p. 26 reads:

'The Goat carries the destructive work further. He is the 'bete noire', the desert maker. Nothing is safe from his insatiable appetite. In arid and semi-arid regions where the goat is the principal factor in the economy, it has rapidly denuded the soil of all vegetation. In a region in Morocco, the goats shown in the illustration (photograph of goats in a tree browsing on the foliage) have assaulted trees. Elsewhere, whether in the Mediterranean area, New Zealand, South America, or the Caribbeans, the misdeeds are astounding.'

There is no doubt that the goat is the most destructive of all the herbivorous animals; no form of vegetation seems to survive the appetite of this hardy, sure-footed, prolific little animal. Its powers of adaptation to new terrain are astounding. Even in periods of drought when other animals are dying of starvation, the goat seems to flourish. It is the mainstay of many desert dwellers and provides most of their needs. The 'evil deeds', whorling round in its brain are masked by its 'stupid' look, accentuated by its horizontal pupil! Its appearance belies it. However, the point of interest lies in the fact that in the neighbourhood of Bombay, the City Fathers and others try to encourage the planting of trees along the roads to shelter the wayfarer from the burning rays of the sun. Unfortunately, some of these trees constitute *excellent* goat feed and the good efforts are brought to naught by the local 'goat keepers', who systematically defoliate the trees, some of the figs in particular, just at the time when the trees are putting forth the new shoots and foliage and when the shade is most welcome. Frequently, I remonstrated with these despoilers who either fled when accosted or replied that they had bought the right to divest the trees from the municipality! At that time I was informed that these vandals paid Rs. 3 per tree to the municipality annually by way of a fee to carry out their depredations. True, this system must have contributed a fair annual sum to the coffers of the municipality, but it left the public (who contributed by way of taxes to the planting of the trees) with malformed and dying trunks lining the roads. Long stretches without trees—the gaps caused by 'goat feeders'—were not uncommon. Perhaps some legal brain would have difficulty in answering the question, Whose property are 'private' goats fed on 'public' property? !

The destructive powers of the goat are, perhaps, best expressed in a belief that 'if a goat nibbles a plant it is sure to die'. Some virtually believe that the goat's saliva is 'poisonous'. The truth of the matter is that once a goat starts on a plant he usually completes the job thoroughly.

Incidentally, while on the subject of the denuding of trees, the prevailing system in many parts of India and perhaps in other countries of pollarding trees during the hot season, to obtain material to burn in the fields before the arrival of the monsoon for the sake of the little potash, has accounted for the deforestation in many areas. The period of pollarding is unfortunately at a time when most of the trees are putting forth new growth. Further, it is also the time of high winds which frequently blow away the ashes before the arrival of the rains to settle them. Thus, perhaps, except for the sterilization of the soil in the fields intended as nurseries for the crops, little advantage is gained, but irreparable damage is done to the surrounding forest. The cut branches and dead leaves are frequently brought from long distances. Much of the deforested areas have been created in this way. In time villages have had to move to keep near the receding forest. Other serious consequences have followed in the wake of this system. Parts of the Konkan are good examples. Criticism is simple, but constructive proposals are more than difficult. Perhaps, in time the advance of agricultural knowledge brought home to the villagers, and a generous supply of cheap fertilizers possibly subsidized by the Government, may relieve the situation somewhat and spare the trees and forests for posterity.

DOMINION MUSEUM,
WELLINGTON, NEW ZEALAND, C. McCANN
*February* 3, 1956. *Vertebrate Zoologist.*

## 8. NESTING OF THE YELLOWEYED BABBLER (*CHRYSOMMA SINENSIS* SSP.) IN THE MADURA DISTRICT, MADRAS PRESIDENCY

Nichols in his survey of the 'Birds of the Madura District' refers to the Yelloweyed Babbler as uncommon in the Madura District and makes no mention of it breeding in the area.

A nest with a clutch of four fresh eggs was taken by me on 23-11-1931 in light scrub jungle in the Gandamanayakkanur Zamindary, at the foot of the High Wavy Mountains, in the Madura District.

Extracts from recent articles in the *Journal* in which there are references to this babbler are quoted. Only one record refers to birds near Bombay and the breeding period is stated to extend to the end of October. The period for South India is covered by the period June to August.

(1) F. N. Betts 'Birds of Coorg', 50 (1): 29. Nest middle of June, but not quite certain of the species.
(2) Sálim Ali 'Birds of Mysore', 43 (3): 321. Records Phythian-Adams taking two clutches of 4 eggs each on the 12th and 13th June near Gundlupet.
(3) Sálim Ali and Humayun Abdulali 'The Birds of Bombay and Salsette', 39 (1): 96. Nests from July to the end of October, during the rains.
(4) Baker and Inglis 'Birds of South India'. Breeding season June to August.

The record, 23-11-1931, in the Madura District, although an isolated one until further data are collected from the eastern areas of the Madras Presidency, would suggest that breeding takes place during the NE. Monsoon in areas where there is very little, if any, rainfall in the SW. Monsoon.

The breeding period recorded in 'The Birds of South India' would appear to require revision as records seem to indicate that breeding coincides with the monsoons in South India.

51, Ellerton Road,
Wandsworth Common,
London, S.W. 18,
*February* 28, 1956.

C. H. BIDDULPH

## 9. OCCURRENCE OF THE REDFACED MALKOHA, *PHOENICOPHAUS PYRRHOCEPHALUS* (PENNANT) IN MADURA DISTRICT, MADRAS PRESIDENCY

Nichols in his list of the 'Birds of the Madura District', (Volume 44, Nos. 3 and 4 and Volume 45, No. 2), does not include the Redfaced Malkoha.

Sálim Ali in 'The Ornithology of Travancore and Cochin', Volume 39, No. 1 of the *Journal*, doubts Stewart's and Legge's records of the bird's occurrence in South Travancore.

I confirm that the Redfaced Malkoha occurs in South India as I had an opportunity of observing one for some time when it was undisturbed and unaware of my presence. My record is dated 26-11-1931, the locality being the Varashanad forested area of the Gandamanayakkanur Zamindary, at the foot of the High Wavy Mountains, in the Madura District.

There is no possibility of mistaken identification as the time was about 4.30 in the evening, I was seated on a machan and the Malkoha flew on to a tree facing me and not more than 30 to 40 feet from the machan.

It remained on the tree for a sufficient period for me to observe it closely and I made the most of the opportunity as it was the first occasion on which I had seen a live bird of this species in its natural habitat.

It changed its position on the tree while I watched and made its harsh call three or four times. This call, or note, has been correctly described by Legge and it was its loud call which first attracted my attention.

The crimson cheek patches were unmistakable and very prominent. I noted its approximate size and shape, coloration, shape of beak and length of tail in relation to the body.

This record of its occurrence, coupled with those of Stewart and Legge, must, I think, establish the fact that this Malkoha is not restricted to Ceylon and that it does occur in favourable localities in the far south of the Madras Presidency and in the Cochin-Travancore area.

As it is unlikely the specimen seen by me was a stray from Ceylon, specimens should be secured by sending a collector to the area during the months of November and December.

51, Ellerton Road,
Wandsworth Common,
London, S.W. 18,
*February* 28, 1956.

C. H. BIDDULPH

## 10. OCCURRENCE OF THE BLACKCAPPED KINGFISHER, *HALCYON PILEATA* (BODDAERT) AT COIMBATORE, SOUTH INDIA

We have received from Mr. B. Subbiah Pillay of Coimbatore a specimen of the Blackcapped Kingfisher (*Halcyon pileata*) which was shot on 23 December 1955 on a channel near the River Noyal at Coimbatore. This species is well known along the coasts of South India, but the above is worth recording since there does not appear any record of its occurrence so far inland. Coimbatore is about 75 miles from the Malabar Coast.

Bombay Natural History Society,
114, Apollo Street,
Fort, Bombay,
*March* 9, 1956.

EDITORS

## 11. HOOPOE (*UPUPA EPOPS*) AT SEA

On a voyage between Bombay and Aden a hoopoe was seen on the ship at 10 o'clock on the morning of 17-2-1937, when the ship was about 35 miles off the Arabian coast and about 70 miles from Aden.

On two occasions it looked as if the bird had left the ship for the land, but after flying a short distance it returned and rested on the ship. It eventually left the ship when it was nearing Aden.

The weather was calm and had been so for some considerable time and there was no question of the bird having been blown out to sea.

Questions which arise from this observation are:

(*a*) Could it be suggested the point where the crossing was being made was an unusual migratory route for small birds moving from the African continent eastwards? A route a little more to the north would have involved less effort and risk by having a shorter sea crossing.

(*b*) Is there evidence that migration does in fact take place in this area?

(*c*) Are records available of the species that move eastwards and the periods during which these movements occur, i.e., outward and return migrations?

(*d*) To what sub-species is it suggested the hoopoe may belong which was moving from Africa towards the east and the maximum extent of the migration?

51, Ellerton Road,
Wandsworth Common, C. H. BIDDULPH
London, S.W. 18,
*February* 28, 1956.

[It is difficult to guess what this hoopoe could be doing so far out at sea in mid February, which is surely too early for the regular spring migration.

Although of no direct bearing on the above note or answering any of the correspondent's questions, reference is invited to the short notes on 'Land Birds on Board Ship' on pp. 638-40 of the *Ibis* 1934, where several migratory species of European land birds are reported coming on board in mid winter in the Mediterranean during an outward voyage from London.

There is a note in the *Journal* (30: 222) of a hoopoe travelling all the way from Bombay to Gibraltar on a P. & O. Liner, a voyage which must have involved at least 10 days!—Eds.]

## 12. BESRA SPARROW-HAWK (*ACCIPITER VIRGATUS*) IN SAURASHTRA

(*With a photo*)

Trapping of birds of prey useful in falconry has been an annual feature in Bhavnagar for well over two generations, and the experience gained in identifying a variety of hawks, their training, etc.

has been considerable. Each year new hawks are trapped, and there is always some bird in a particular colour phase which is of unusual interest. Last year His Highness the Maharaja of Bhavnagar sent his men out to capture Sparrow-Hawks in the Victoria Park, Bhavnagar, a thicket in which rare catches such as Goshawk (*Accipiter gentilis*), have been made (see *JBNHS*, 52: 211). This time it was a Besra Sparrow-Hawk. The bird was caught on 14 December 1955 in a net under which a live Common Myna was tied as bait. The Besra was an immature female and measured as follows:

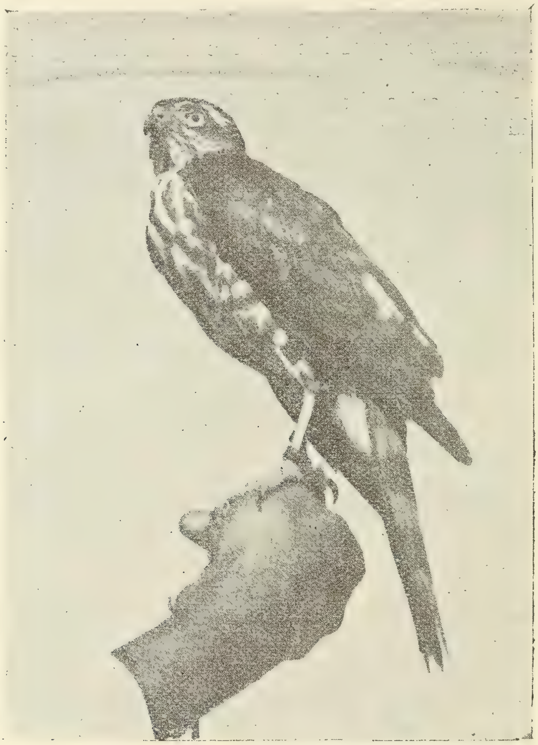


*Photo by H. H. Bhavnagar.*

The Besra ♀.

Wing 185 mm.; bill 21 mm.; tail 150 mm.; tarsus 57 mm.

The main identification of the Besra is by its slim and long middle toe and thin tarsus, as in the Sparrow-Hawk (*Accipiter nisus*)—very different from that of the Shikra, and by the broad mesial stripe on the chin as in the Shikra. In the adult phase, the Besra has the crown darker than the Shikra's and its breast is more uniformly marked. A distinct supercilium, as in the Sparrow-Hawk, is present. The general build is that of the Sparrow-Hawk, but with a comparatively short tail, which has distinct broad bands. The soft parts of the Besra captured were as follows:

Eyes golden yellow; cere yellowish green; legs greenish yellow. But for the mesial stripe, the bird closely resembled a Sparrow-Hawk.

Although I have seen the Besra in the field in Gujerat I was never very sure of seeing one in Saurashtra. So, this is the first authentic record of the species in Saurashtra, though our falconers always maintained they had seen some. In the field the Besra is not at all easy to identify unless at close quarters, and this is the reason why there is so little information concerning it in Western India. The bird has been used in falconry since ages, and is well-known. It is faster than the Shikra, and though smaller than the Sparrow-Hawk, it is hardier, but less so than the Shikra. In Saurashtra the Besra is undoubtedly a winter migrant. It has not been mentioned by Sálim Ali in his list of Gujerat birds.

42, Koregaon Lodge,
Koregaon Park,
Poona,
*February* 18, 1956.

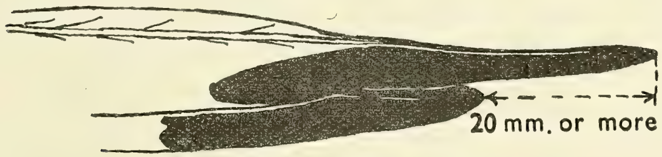
R. S. DHARMAKUMARSINHJI

## 13. EXTENSION OF THE KNOWN RANGE OF THE COLLARED PRATINCOLE, *GLAREOLA PRATINCOLA PRATINCOLA* (LINNAEUS), IN INDIA AND CEYLON

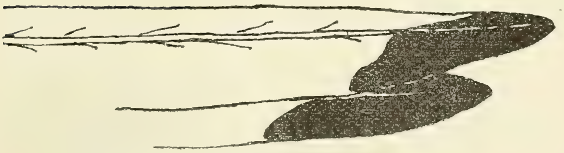
On 28 December 1955, Mr. B. Subbiah Pillay shot one of a pair of Swallow Plovers at the Big Tank at Coimbatore, South India. As this was immature and there was some difficulty in identification, Mr. Pillay visited the place again on 9 January and shot the other which was in adult plumage.

From the depth of the tail fork and the white edges to the middle secondaries, the adult appeared to be *pratincola*. In the absence, however, of definitely named specimens in the Bombay collection, as also of any records of either *pratincola* or *maldivarum* from South

SHAPE AND PATTERN OF OUTER TAIL FEATHERS



*Glareola pratincola*



*Glareola maldivarum*

India, I wrote to Mrs. B. P. Hall at the Bird Room, British Museum (Natural History), and she has been good enough to draw my attention to the shape and pattern of the tail which she considers a wholly reliable diagnostic character as between the two species (or races), there being no intermediate specimens. In *pratincola* the outermost tail feather is *over* 20 mm. longer than the second, while in *maldivarum* it is *under* 15 mm. longer.

Mrs. Hall also advised that in the British Museum there are specimens of *G. pratincola* from Sind, Ahmedabad and Ratnagiri (immature, 22 August) and also two collected in Ceylon in February 1951 by Lt.-Col. W. W. A. Phillips at Kalametiya lagoon, near Ambalamtota, in the Hambantota District (sea coast) of the Southern Province. He shot them from a fairly large flock comprising 30-40 pratincoles which were resting on an open grazing ground near the lagoon.

In 'Birds of Saurashtra', Dharmakumarsinhji refers binomially to *G. pratincola.* Three specimens obtained by him at Bhavnagar are in Bombay and are *maldivarum.* Sálim Ali in his recent 'Birds of Gujarat' omits the Swallow Plovers altogether.

In *JBNHS,* 40: 633, I recorded *Glareola maldivarum* as a straggler around Bombay. The two specimens then obtained are both in immature plumage and show white tips to the secondaries. The other differences are, however, in keeping with that form, and it is possible that the white tips to the secondaries are lost in the adult plumage.

In addition to the above records of *pratincola* from Ahmedabad and *maldivarum* from Bhavnagar, attention may be drawn to Littledale's note on the Small Pratincole (*G. lactea*) breeding on the Mahi River, above Wasod (*JBNHS*, 1: 200).

C/O MESSRS FAIZ & CO.,
75, ABDUL REHMAN STREET, HUMAYUN ABDULALI
BOMBAY 3,
*April* 12, 1956.

[The Fauna of British India—Birds, Vol. VI, p. 90 gives the distribution of *G. p. pratincola* as: 'S. Europe, C. and W. Asia to Sind and Kutch. In winter it wanders into Africa. In India it breeds in Sind, and straggles as far as Allahabad, the Deccan and Ratnagiri.'—EDS.]

## 14. KENTISH PLOVER (*CHARADRIUS ALEXANDRINUS*) AND LITTLE RING PLOVER (*CHARADRIUS DUBIUS*) NESTING IN SOUTH INDIA

Whistler in Vernay Scientific Survey of the Eastern Ghats (*JBNHS*, 39: 250) identified two specimens of Kentish Plover from the Godavari Delta as of the typical race and separated the form resident in Ceylon as *leggei* on its smaller size and the absence of a chestnut cap in its breeding plumage.

Though the typical race is known to breed in Saurashtra there appears to be no record of its nesting in Peninsular India, and it may therefore be worthwhile noting that at Cuddalore, South Arcot District, Madras, I saw birds with young ones on 30-7-1948 and later in the year had another young one in my hand. Again on 13 April 1954 I found two (or three) newly hatched young ones. On 12 August I saw at least 11 young ones running together with their parents. It therefore seems to breed regularly in Cuddalore. On 11 April 1956, I also took a clutch of three hard set eggs in a depression in the sand close to an *Ipomoea biloba* plant, which were sent to the Natural History Museum in Bombay.

Although I looked carefully for the distinct chestnut cap which the typical race is known to assume in the breeding season, I could never see it, and I therefore presume that these birds are close to the Ceylon race *leggei*.

On 10 July 1955 I found the Little Ring Plover (Charadrius *dubius*) with two small young ones at the Gadilam River near Attur (40 or 50 miles from Cuddalore). I think it is also breeding regularly in this district.

DANISH MISSION,
ULUNDURPET,
SOUTH ARCOT,
*May* 24, 1956.

A. KREBS

## 15. OCCURRENCE OF THE SPOTTEDBILLED PELICAN, *PELICANUS PHILIPPENSIS* GMELIN, IN THE VEDANTHANGAL HERONRY

The Vedanthangal heronry in the Chingleput District, South India, has been in existence for over a hundred and fifty years and has been described by Hume (Nests and Eggs of Indian Birds III : 238-239), Capt. Packard (*JBNHS*, 15 : 138-139), Capt. Bates (Bird Life in India 20-47) and by Whistler and Kinnear (Vernay Scientific Survey, *JBNHS* 39 : 447-456). None of these earlier surveyors have recorded pelicans from this heronry. Some of my friends here who have been visiting the heronry every year for over fifteen years and I myself, visiting it frequently for the past five or six years, have never seen one.

On my first visit to the heronry this year on the afternoon of 4 February 1956, along with other amateur bird watchers, we saw no pelicans. But when I revisited it on the afternoon of 27 February, as soon as I arrived there at about 4 p.m. the watchman of the sanctuary drew my attention to a large solitary bird swimming, *madhali kokku* as he called it in Tamil, meaning 'a large stork'. I looked through my field-glasses. No doubt it was a heavy bird—a pelican. It was swimming slowly alone in deep water just beneath the nesting trees in the middle of the heronry tank. It did not appear to be fishing. The heronry was almost desolate because most of the day-feeders like Cormorants, Openbills, Spoonbills, White Ibises and Darters which exist in larger numbers in this heronry were away on the feeding grounds elsewhere, and the few staying back were either sunning themselves on the trees, or preening on the islets, or swimming and fishing in the water. This solitary pelican later flew off to a nearby tree, where there was one more of its tribe along with Cormorants and Openbills, with which they seemed to be quite at home.

I could not clearly see the spotted nature of the bill since the birds were about a hundred yards away from the tank bund where I was but the dull purple pouch, the general colour of the plumage, etc., agree with those of the Spottedbilled Pelican, which is supposed to be the one occurring in South India.

I was informed by the watchman that they do occasionally visit the heronry in small numbers, a rare visitor indeed, and never stay long, at the most two or three days. In fact seven pelicans arrived there that morning as he said, and some left earlier and I could see only these two remaining there till the evening. Unfortunately I was not there till late in the evening to see whether even these two roosted here at all. He said that they do not nest in the heronry and I could see no indication of their permanent stay or breeding there either.

This is the first time that pelicans are recorded on an open jheel from anywhere in the suburbs of Madras City on the East Coast. Pelicans being sporadic in their distribution in South India, their occurrence in the Vedanthangal heronry is therefore interesting.

DEPARTMENT OF ZOOLOGY,
MADRAS CHRISTIAN COLLEGE, P. J. SANJEEVA RAJ
TAMBARAM, CHINGLEPUT DISTRICT,

[For a good account of the Spottedbilled Pelican breeding in South India see Neelakantan, *JBNHS*, 48: 656-666.—EDS.]

## 16. SOME OBSERVATIONS ON THE BREEDING BEHAVIOUR OF THE CHESTNUT BITTERN *IXOBRYCHUS CINNAMOMEUS* (GMELIN) AND THE BLACK BITTERN *DUPETOR FLAVICOLLIS* (LATHAM)

In the Gayathri River in Kavasseri, Malabar, there are some clumps of screwpine planted along the river bank to prevent erosion. Most of these are small thickets covering a few square feet, but one extends along the bund for 30 yards and is about 2 yards broad. These are normally left severely alone by the local people as they are believed to harbour an extremely poisonous variety of cobra. Some 8 to 10 pairs of Chestnut Bittern, 2 or 3 pairs of Black Bittern, and one pair (2 in 1955) of Little Green Heron find in these screwpine thickets ideal nesting sites every year. In 1942 and 1943 I took eggs of both Black and Chestnut Bitterns, and in subsequent years saw other nests of these two bitterns regularly.

The Black and Chestnut Bitterns seem to be local migrants arriving in Kavasseri about the second week of May, soon after the first showers. At first they are very shy and hard to flush, but early in June they begin to sally forth as early as five o'clock in the evening, and a few days later may be seen even at noon, flying about or standing under the bushes.

As far as I could see, the Black Bittern was more retiring and unobtrusive, and apparently quite voiceless. The Chestnut Bittern, on the other hand, announces its presence by frequently producing a hollow booming note which is uttered from its perch within the bush or from the ground. When on the wing it has a different note—a cross between a croak and a chuckle. This short croak is uttered when the bird flies about chasing others and, at times, even when it is sitting inside a bush. It appears to serve as a warning note also. The hollow booming is in the nature of a 'song', and plays an important part in an aggressive display indulged in by the males alone.

As nothing seems to have been published about this aspect of the bird's behaviour, I should like to adapt from my notes an account written on 12 June 1955:

'Time 16.30 hrs. Weather dull. All afternoon it had drizzled. The birds were watched at distances varying from 40 feet to 60 yards, mostly from the south-west, through 10 × 45 field glasses. A nest each of the Black and the Chestnut Bitterns had been discovered a week ago, 5 June.

'During the two hours I spent in the river today saw only male Chestnut Bitterns. Frequently these birds flew about. When one flew out of the screwpine bush, another would come out at once from another place in the clump and pursue it. Often one or two more would come out and join these, and then they would fly round and return to their respective places, or alight under different bushes. This chase was never seen to involve any sort of quarrelling; but it looked as though they had a convention that no male bird should be allowed to fly about alone. Often, at the beginning of the chase or in the course of it, one or two birds would utter a series of harsh chuckles. When two different pairs of males flew about like this, they tended to join up and form one party. If one of the birds alighted on the sand towards the end of the chase (which normally was just one round across the bed of the river, some 75 yards broad), one or more of the others would fly low over its head as though they wished to give it a peck. The sitting bird would immediately either duck or thrust its neck up, and, at times, rise again to join the others. Rarely did this chasing take more than a couple of minutes, or consist of more than one 'round trip' across the river bed.

'At times a male bird would fly down and alight on the bank at the foot of the clump. Then with bill pointing up, neck half stretched, it would cause the sides of its throat to swell and begin the hollow "*gok-gok-gok-gok-gok . . .*" call. Another male sitting some 15 to 20 ft. away would become alert at once, and either advance towards the other (the challenger) or, after flying part of the way, alight 10 ft. away from him. In either case, most often, the second bird would utter a couple of sharp chuckles, which seemed to be their way of declaring that the challenge was accepted. Then, invariably, one of the two would begin to advance towards the other, the birds almost simultaneously lowering their heads meanwhile keeping the bill horizontal and pointed straight at the rival. The posture of the birds at this time should have been called the "on guard" position, for the bill is held exactly as the soldier's bayonet is, and the bird which advances is as watchful as the soldier, though it is not inclined to "charge" at any time. The other bird would either wait for its opponent to draw near, or advance a few paces. The bird which covered a greater distance, that is, the more aggressive one, invariably stalked, taking advantage of all available cover. There was much more than a hint of cunning in the way the bird walked up towards its rival. The deliberate placing of the feet suggested the soldier's "ghost-walk".

'It was noted that, most often, as the birds took up the crouching position, the paler patch and the normally hidden "arrowhead" feathers on the shoulder became evident. But there was never any hint of plumage display—even the curious shoulder patches not appearing to be brought into use for the purpose of intimidation. (See the marvellous photographs : *JBNHS*, Vol. 53, No. 1.)

'Quite often something or other, an intruding buffalo or a passing cowherd, interrupted the display and sent one or both birds flying back into their bushes. At times, however, it went on uninterrupted. Then the birds came very close to each other, thrust out their necks (like mediaeval knights-errant tilting at a tournament), but never seemed to make contact. They would then simultaneously leap a couple of feet into the air, meet without any real impact, and fall back, wings wide open to break their fall.

'Rarely did the challenging *gok-gok-gok* of a bird out in the open go unnoticed. But, curiously enough, only one bird seemed to take up the challenge at a time; never was more than one (on this or on other days) seen advancing towards the trumpeter.

'One of the birds watched today seemed to be in greater "heat" than the others. It uttered the booming challenge four or five times at least within the two hour period, and was invariably answered by another bird which occupied a clump some 20 feet to the east. This desperate challenger once actually went in search of the other bird when it uttered the *gok-gok-gok* . . . from its bush. It walked rather fast, but carefully and in a crouching position, constantly looking up, and to right and left, as it went on. But when it had gone up to within 3 ft. of its rival, the other bird began to advance boldly, and our eager champion, instead of meeting the foe on his home-ground, at once flew off with the other in hot pursuit. They flew a half circle and alighted on a sandbank near their original stations, but on the other side of a narrow stream of water. One of the birds fell into the stream, and had to swim a distance of one or two ft. to reach hard ground. On the sandbank they sat 10 to 12 ft. apart, but both faced east instead of facing each other. The one which had got a ducking then flew back to its bush.'

Black Bitterns also indulge in a similar chase, but without any apparent prelude such as the booming. Moreover, their chase invariably begins when one bird leaves its bush, never after any sort of display. On 14 June a second nest of the Black Bittern was discovered. I had previously flung a few handfuls of gravel into the bush to see if it was occupied, but nothing had stirred. It was by an accident that I saw the sitting bird. It seemed quite confident that no one could find it, and did not even put up its neck to 'freeze'.

But it leaned to one side and peered at me, very like a curious woman peeping from behind her door. After a while it lost courage and, instead of attempting to freeze as these birds normally do, flew off. As it was passing the clump where the nest discovered on the 5th was, a Black Bittern which had been quietly brooding rose from the nest and flew after the first one. They went round (exactly like the Chestnut Bitterns, but more slowly, and quite silently) and alighted on clumps away from their nests.

Though similar chases have been witnessed often, I have never seen a Black Bittern indulging in any sort of aggressive or love display. If these and the Chestnut Bitterns have any courtship antics, I have yet to see them.

On page 4 of *JBNHS*, Vol. 53, No. 1, Mr. Loke Wan-Tho remarks that the Chestnut Bitterns he saw 'did not stretch out their necks . . . whenever danger threatened, but instead preferred to crouch'. Those I have observed invariably stretched out their necks whenever they suspected danger; but, when convinced that their presence had been discovered, they often crouched or just flew away.

Male Chestnut Bitterns never behaved aggressively towards Black Bitterns. The nests, one of the black and the other of the Chestnut Bittern, found on 5 June this year, were just two or three feet apart and almost at the same height. As a rule, the Black Bittern builds 6 to 10 ft. above the ground, and the Chestnut Bittern at heights ranging from one to three feet. The distance, measured along the ground, of the Black Bittern's nest from water is also much greater than that of the Chestnut Bittern's. The chestnut bird tends to build right over the stream, whereas the other places its nest near the bund. In this instance both birds had nests about 6 ft. from the water-level and just over the edge of the stream.

The Chestnut Bittern's nest is constructed entirely of pandanus leaves. The Black Bittern's is made of creeper stems and other very slender twigs. Among the screwpines there grow also some thickets of henna; and the Black Bittern, more often than not, builds its nest on the intertwined twigs of this plant.

### THE LITTLE GREEN HERON, *Butorides striatus* (Horsfield)

As the breeding of the Little Green Heron also seems to have been unrecorded from these parts, it may be interesting to note here that in the second week of June 1955, there was a nest of this bird in a screwpine bush at the place where I watched the other bitterns. The nest was 10 to 12 ft. above the ground, well within the bush, and very difficult to see. There were at least two chicks in it. They had short yellowish bills, and were covered all over with pale greyish down.

As I used to spend some time almost every evening in May and the first two weeks of June near these screwpine clumps, and never saw a Green Heron going anywhere near this particular bush except on the 12th (when the nest was found only because the bird lost its foothold while quietly slipping into the bush, and was seen flapping its wings desperately), I was able to understand why I had not succeeded in my search for the nest of the Little Green Heron for nearly fifteen years, though, during every monsoon season, a pair used to haunt this area.

On 14 June, just 15 yards away from this nest, I saw a pair of adult Green Herons sitting with a fully fledged young one. The young bird was able to fly very well, but lacked the black cap and crest of the adults. On the closed wings it had white streaks in the place of the adults' green. It looked as though there were two different pairs of Green Heron in the area this year. I had noticed earlier in the season more than two adult birds moving about.

Government Victoria College,
Palghat, K. K. NEELAKANTAN
*February* 9, 1956.

## 17. REDBREASTED MERGANSER (*MERGUS SERRATOR* LINN.) IN SIND

It may possibly be of interest, in view of the remarks on the distribution of the above bird in the 'Fauna' (vi: 474), to record having observed one closely today at Baleji, about five miles as the crow flies west of Manora, Karachi. It was female.

I am well acquainted with this bird having seen it on the coasts of Britain as well as on both the east and west coasts of America. Today it was feeding in shallow water among the reefs at Baleji, low tide, about 3 p.m., visibility perfect. I was using 8 x 30 binoculars and had very good views of it on the water and flying as I stalked it up and down the rocky coast.

Diagnostic features were: in flight, the white squares on the wing, low carriage of neck and head. On the water, low carriage and erect neck: pinkish buff head and neck paling to pure white throat and front neck, red bill, long and thin. There was a distinct crest. Back greyish shading into buff on the flanks near the tail.

6, Ghizri Road,
Karachi, N. A. LESLIE
*December* 26, 1955.

[According to Dr. C. B. Ticehurst, Birds of Sind (*Ibis* 1923, p. 458) it would appear that though not very uncommon on the Mekran Coast, the only authentic record of its occurrence in Sind was one shot by Capt. Yerbury in Karachi Harbour (in 1877). Our correspondent's attention was drawn to the close superficial resemblance between the female of this species and that of the less rare Goosander (*M. merganser*), but he confirms that it was as recorded.—Eds.]

## 18. SOLAR ECLIPSE AND ANIMAL BEHAVIOUR

Having come across several discussions in literature on the possible relationships of certain aspects of animal life with solar phenomena, particularly sun spots, I was piqued to know if solar eclipse in any way influenced animal behaviour. So, when the opportunity presented itself on 14 December 1955, I made a tour of the Zoological Gardens at Trivandrum with a view to see if captive animals reacted in any marked manner to the eclipse. As I walked about, I kept an eye on the wild birds too for any sign of deviation from their normal behaviour. Set forth below is a summary of my observations, classed for the sake of convenience under a few headings of behaviour patterns. This evidence, if anything, tends to point in the negative direction and indicates that, contrary to popular notion, animals either captive or free display little or no responsive behaviour during a solar eclipse. It would be interesting to know how these observations compare with those of any of the readers of your esteemed journal.

The solar eclipse of 14 December 1955 is, according to the Trivandrum Observatory, the longest on record in the last twenty-five years, having had a total duration of 4 hours and 21 minutes, starting from 10.37 a.m. At 12.00 hours, there was a noticeable pallor all around as if the whole sky was charged with rain clouds. By 12.35 hours, the pallor had deepened so much that it was quite dark inside the museum and lights had to be turned on. Shortly after 12.00 hours, I felt a sudden chill seizing me and, from then on, one could walk about in the bright sun without the shelter of an umbrella. This corresponded with a fall of temperature, as registered at the Observatory, from 82.6°F at 12.00 to 80.6°F at 13.00 and to 80.4°F at 14.00 hours. There was also a slight fall of atmospheric pressure but a gain in humidity by 9%.

I am thankful to the staff of the Trivandrum Observatory for their courtesy in letting me have their readings during the eclipse.

## SUMMARY OF OBSERVATIONS

### A. CAPTIVE ANIMALS

Feeding:

Sambur, Zebra, Muntjac, Nilgai, Indian Elephant, Gnu, Donkey, Pig, Giraffe, Golden Pheasant, Toucan.

Chewing Cud:

Sambur, Blackbuck, Fourhorned Antelope, Nilgai, Spotted Deer, Freak Bull (with an additional eye in the middle of the forehead).

Walking about but not feeding:

Blackbuck (albino).

Resting or Sleeping:

Pig, Kangaroo, Barbary Sheep, Gaur, Spotted Deer, Brown Bear, Lion, Tiger, Panther Hyaena, Otter, Porcupine, Toucan, Hornbill, Tortoise (*Testudo* sp.), Python.

Caressing:

Giant Tortoise.

Preening:
Emu, Otter (rolling on ground: mangy).

Miscellaneous:
Pecking at railing of paddack: Ostrich. Pacing inside cage: Sloth Bear, Jackal. Inside water: Hippopotamus family, Crocodile.

### B. Free-ranging Animals (Birds)

Calling:
Indian Jungle Crow, Ceylon House Crow, Tree-pie, Southern Magpie-robin, Black Drongo, Willow-Warbler, South Indian Black-headed Oriole, Common Myna, Small Green Barbet, Coppersmith, Indian Koel, Roseringed Parakeet, Bluetailed Bee-eater, Indian Spotted Dove.

Soaring:
Common Pariah Kite.

Hawking:
Bluetailed Bee-eater, Palm Swift.

Food-getting:
Black Drongo, Indian Whitebreasted Kingfisher.

Feeding:
Indian Blue Rock Pigeon.

Bathing:
Common Myna in bison's drinking trough.

Flying past:
Indian Purple and Purplerumped Sunbirds, Flowerpecker and Indian Blue Rock Pigeon.

'Gokulam',
Nantencode, Trivandrum, N. G. PILLAI
*February* 16, 1956.

[The accounts frequently appearing in newspapers of crows and other birds being deceived by the temporary darkening by solar eclipse and flying to their nightly roosts at mid-day seem farfetched considering the delicate innate sense of chronometer time birds possess. And surely even at the peak of total eclipse the darkness is no greater than on some of the heaviest overcast monsoon days. Why, then, does one never see or get reports of birds retiring to their sleeping roosts on such monsoon mid-days?

However, the alleged reactions of birds to solar eclipse are certainly worthy of a more scientific and critical investigation.—EDS.]

## 19. A BLIND SNAKE FROM NEPAL

We recently received from Shri B. L. Karmacharya a Blind Snake collected in Nepal by Shri Bandhu Pant which we were unable to identify satisfactorily.

Its lepidosis, as compared with *Typhlops jerdoni* Boulenger and *T. tenuicollis* (Peters) was as under:

| | Scales round midbody. | Transverse rows of scales | Eyes distinct or indistinct | Nasal |
|---|---|---|---|---|
| Present specimen ... | 22 | 360 | Indistinct | Completely divided |
| *jerdoni* ... | 22 | 260–280 | Distinct | do. |
| *tenuicollis* ... | 22 | 480–520 | Indistinct | Incompletely divided. |

In the absence of any material for comparison it was sent to the British Museum (N.H.) whence Mr. J. C. Battersby of the Reptile Section writes: 'I have examined the *Typhlops* No. 172S from Nepal and agree with you that the nasal is completely divided. Another point against it being *tenuicollis* is that the diameter of the body is about 38 and not 65 times in the total length. Although the number of transverse rows of scales given by you differs from the number given for the species in Smith's F.B.I., I think it is an example of *jerdoni* Boulenger. I have compared it with the paratypes with which it quite well agrees, also with some specimens we have from Darjeeling, which have about 298 scale-rows. The fact of the eye not showing is due, I think, to this specimen being about to slough. The number of scale-rows I imagine can be widely variable, although (the difference of) 80 in this case is well above the given range.'

It would be interesting to examine more specimens from the same area and determine if this increase in scale-rows is an individual variation or common to the population in this area. Nepal is further west of the recorded range which, according to Malcolm Smith's snake volume in the Fauna, p. 50, is Eastern Himalayas (Sikkim, Darjeeling, Duars Dts.), Assam (Abor and Khasi Hills), Upper Burma (Lashio), Pegu.

NATURAL HISTORY SECTION,
PRINCE OF WALES MUSEUM, V. K. CHARI
BOMBAY 1,
*April* 16, 1956.

## 20. FURTHER EXTENSION OF RANGE OF THE FROG, *UPERODON GLOBULOSUM* (GÜNTHER) IN JALPAIGURI, WEST BENGAL

During the cultivation of a piece of land in the Agricultural Farm of Jalpaiguri, northern Bengal, two frogs were exhumed from the field. Sri Saumendra Kumar Das, Research Assistant in Entomology, Government of West Bengal, at once recognized the frogs as rare and interesting forms, and kindly presented them to our laboratory in a well-preserved condition. We are greatly indebted to him for this gift.

The globular shape of the body, the tiny head with dark bead-like eyes, and the much shortened hind limbs with shovel-shaped metatarsal tubercles are so characteristic that we had no difficulty in identifying the frogs as *Uperodon globulosum* (Günther) (*vide* Parker, 1934).

According to the previous records from Bengal (Mukerji, 1933; Bhaduri, 1945) it is evident that *U. globulosum* is of rare occurrence. In 1945 Bhaduri mentioned that the total number recorded then was only ten, of which four had been collected from Bengal. He further stated: '*U. globulosum* also enjoys a somewhat wide distribution, it being found in Madras Presidency, Central Provinces and Bengal, although numerical records from these areas are few and far between. All the same, it may be presumed that it is not so common as its ally *systoma* in any of these areas.' However, the present record includes two more specimens from Bengal. The presence of *U. globulosum* in Jalpaiguri in northern Bengal, particularly as it is situated on the border-line of Assam, seems to be an interesting feature. Its occurrence, therefore, in some parts of Assam may not be unlikely from the point of view of distribution.

Very recently Abdulali and Daniel (1954) have discovered nearly a dozen specimens of this species breeding in the Kanheri Caves near Borivli, Salsette Island, Bombay, and they also noted some interesting features of their habits. Evidently they come out of their burrowing habitats for the purpose of breeding on the advent of the first showers of rain in the month of June. However, its particular habitat in the area is yet to be discovered. Nevertheless, the occurrence of *U. globulosum* in fair numbers in Salsette Island, Bombay, considerably extends the range of distribution of this species.

On dissection of the two specimens, the larger one proved to be a female bloated with well-developed ovaries containing pigmented ova; the smaller a male possessing small testes which appeared to be immature. The dusky skin under the throat, as noted by Bhaduri (1945) in the lone specimen, is not evident in the specimen before us. Abdulali and Daniel (1954), who relied on the dark chins only for determining the male sex, did not pay any particular attention to other secondary sexual characters which might have been present in the males, since the frogs were breeding at the time. They, however, noted the breeding females to possess 'numerous pustules' around the vent, which in their opinion may be considered as a secondary sexual character.

MEASUREMENTS (IN MILLIMETRES) OF SOME OF THE BODY PARTS OF THE TWO SPECIMENS:

| | ♂ | ♀ |
|---|---|---|
| Tip of the snout to vent ... ... | 29·0 | 58·0 |
| Breadth of head ... ... ... | 9·5 | 17·2 |
| Eye (orbital diameter) ... ... | 2·0 | 4·1 |
| Snout ... ... ... | 1·5 | 3·0 |
| Orbital end to the tip of the snout ... | 4·0 | 7·1 |
| Upper eyelid ... ... ... | 1·5 | 3·5 |
| Inter-orbital width ... ... ... | 5·0 | 8·2 |
| Outer metatarsal tubercles ... ... | 2·0 | 3·5 |
| Inner metatarsal tubercles ... ... | 3·5 | 6·5 |
| Tibia ... ... ... | 11·0 | 20·5 |

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF CALCUTTA,
35, BALLYGUNGE CIRCULAR ROAD,
*Calcutta* 19.
*February* 28, 1956.

J. L. BHADURI
S. L. BASU

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[Abdulali & Daniel (1954) actually sexed 5 specimens in the breeding season and found the dark chin in all the three males among them. It could be that this characteristic is present only in mature males, and possibly only in the breeding season.—EDS.]

## 21. THE TADPOLES OF *UPERODON GLOBULOSUM* (GÜNTH.)

(*With three text figures*)

The range of distribution of *Uperodon globulosum* has recently been extended to Bombay and reference was made to the tadpoles collected at about the same place and time. (Abdulali & Daniel, *JBNHS*, 52: 637-639). The present notes concern the tadpoles which have not been previously described.

On 13 June 1954, after the first few monsoon showers, a few adults of this species were found floating sluggishly in a rock cistern —one of several—in the Kanheri Caves (*ca.* 1,300 ft.) near Bombay. The cistern held only about 9″ of water which then stood several feet from the top. The water was not examined for either eggs or tadpoles, but the large females of *U. globulosum* collected then were found to have spent ovaries. The breeding season in this area, it would therefore appear, coincides with the break of the monsoon in late May or early June. On 19 June, when the cisterns were overflowing, a large number of actively swimming tadpoles were observed in the above, as also in an adjoining cistern. No adults were then noticed in them.

Unlike other species of Salientia breeding in the same area, the tadpoles of *U. globulosum* were found exclusively in these two cisterns, though there were several other cisterns also containing water at various elevations on the hill.

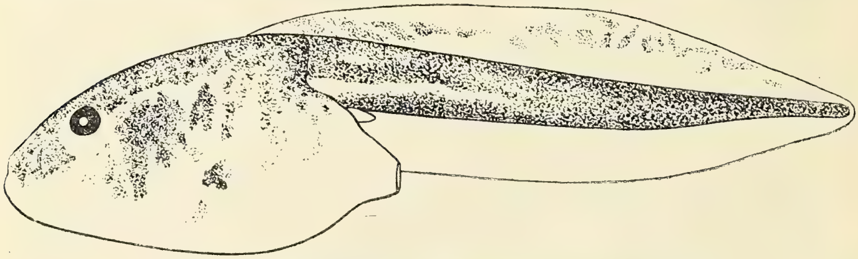
The preference of the adults for these particular cisterns for breeding purposes may be due to their location. These two cisterns are flush with the ground, and thus easy of access to a species with such an extremely limited ability for jumping. They are connected by a small sloping channel through which overflow water runs from the higher into the lower cistern. This slope appears to be the route by which the frogs reach the cistern, since the other approaches are either too steep, or from a higher level.

Since the inner walls of the cisterns are smooth, the frogs which dive into them at the break of the monsoon when the water level within is low, are unable to climb out after egg-laying till the cisterns are brimful and they can float out with the overflow.

Two species of *Rana* (*R. breviceps* and *R. tigrina*) and one species of *Rhacophorus* (*Rh. maculatus*) also breed in the same cisterns. The tadpoles of *U. globulosum* could be distinguished from the others by their smaller size and active habit of swimming freely near the surface, while the others are more sluggish and appear to spend most of their time 'browsing' on the algae on the walls of the cistern. In colour the *Uperodon* tadpoles are olive-brown above, with a whitish tail which is striped longitudinally with dark blotchy lines. The sides and under parts are white, spotted with dark except the centre of the tail which is pure white. In the hand the spots on the under surface are distinctive and have not been noted in any other species of tadpole from around Bombay.

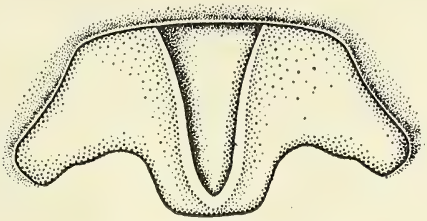
## Description of the Tadpole

The tadpoles are of rather small size. The head and body ovoid, $1\frac{1}{4}$ to $1\frac{1}{2}$ times as long as broad, and rounded anteriorly. The nostrils are close to each other, equidistant between the snout and a line connecting the anterior edges of the eyes. The eyes are supero-lateral, the distance between them $5\frac{1}{2}$ times that between the nostrils.



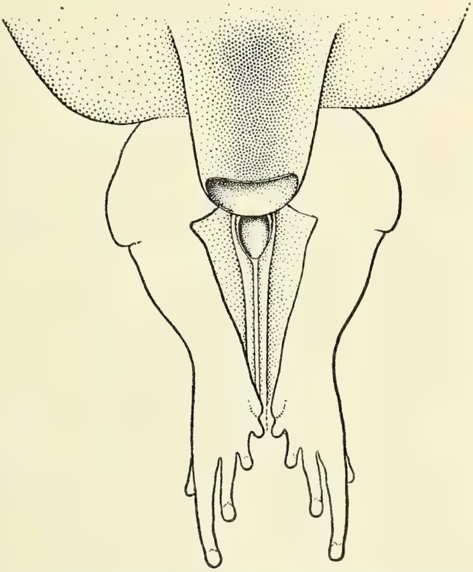
1. Tadpole of *Uperodon globulosum* (lateral view, × 7)

The mouth is almost terminal, more dorsal than ventral, not visible from below, very small; its width is 1/5 to 1/6 that of the head at the level of the eyes. There is no mouth armature. The narrow pigmented upper lip slightly overhangs the lower. The edges of the upper and lower lips at and immediately in front of the commissure extend outwards and form the narrow gape pouches. The lower lip has a small lobe-like projection in the centre which together with the lip is contractile. On the floor of the mouth is a pigmented, somewhat narrow U-shaped ridge; between the arms of the 'U' is a median groove leading backwards to the gullet.



2. Mouth of tadpole, × 40

The spiraculum is a flat transparent median tube, its opening is broad and transverse and terminates in front of the vent which is also median but longitudinal. It may also be noted that the spiraculum is transparent in young individuals, but becomes slightly thicker and pigmented in older specimens.



3. Posterior region of tadpole, showing the median tubular spiracular opening and the anal aperture (ventral view, × 12)

The tail is narrowly pointed, 3 to $3\frac{3}{4}$ times as long as deep and $1\frac{1}{2}$ to $1\frac{2}{3}$ times as long as the head and body. The caudal membranes are moderately deep with convex crests and are almost of equal size.

In smaller specimens the body and the muscular portion of the tail is dorsally pale olive-brown, the colour being made up of fine dots. On the sides and under-surface these dots form irregular splotches, the centre of the belly being least marked and appearing whitish. The tail membranes are almost transparent. In larger specimens, however, the general tone of the colour is somewhat darker, the minute dots being more crowded and the spots on the sides and under-parts showing up more prominently. The area round the nostrils is white sharply contrasting with the dark of the head. The tail membrane is also blotched with brown, especially the dorsal surface. In some specimens the dark muscular portion of the tail is flanked by a white streak on both sides, which merges into the brown towards the distal end.

Total length: 27 mm., head and body: 10 mm., tail depth: 5 mm.

*Localities.*—Kanheri caves, near Borivli, Salsette Islands; Thana. Salsette; Bombay.

*Remarks.*—The tadpoles of *U. globulosum* appear to be almost indistinguishable from those of *U. systoma.* (Ferguson, *JBNHS,* 15: 507, 1904; Parker, A Monograph of the Frogs of the family Microhylidae, p. 75, 1934.)

*Acknowledgement.*—Thanks are due to Sri R. C. Bagchi for the illustrations.

DEPARTMENT OF ZOOLOGY,
UNIVERSITY COLLEGE OF SCIENCE,
35, BALLYGUNGE CIRCULAR ROAD,
*Calcutta* 19.
J. L. BHADURI

NATURAL HISTORY MUSEUM,
DARJEELING,
*February* 28, 1956.
J. C. DANIEL,
*Curator*

## 22. NOTES ON *BUFO STOMATICUS* LUTKEN IN BOMBAY

While driving round the south end of Marine Drive, Bombay City, late at night in July 1956, H.A. heard an unfamiliar amphibian call, and stopped to pick up a toad which proved to be *Bufo stomaticus* and which had not been previously recorded from the area.

The toad which is easily distinguished from *B. melanostictus* by the absence of cranial ridges, the black cornified area of the upper lip and a less warty skin, was later found to be common in the maidan covered with short grass, not far from the sea-wall at the southern end of Marine Drive. The absence of any previous record of this species from Bombay, together with the fact that it was found on recently reclaimed land, leaves a possibility, though unlikely, that it is an introduction.

J.C.D. made several visits to the area and the following is mostly from his notes. Egg strings of a pale translucent yellowish green colour were found loosely wound round the base of grass stems in a few inches of water. The egg strings were 1 mm. in diameter and the eggs about 3 mm. apart. It was not possible to determine the number laid by each female as the individual strings could not be separated from the tangled mass.

The tadpoles which have been described by Annandale and Rao (*Rec. Ind. Mus.* 15: 39) hatched out on the day following collection.

They wriggled within the gelatinous envelope prior to making their way out to the surface. The gills were club-like, with a small knob-like inner gill, followed by another with three branches. The silvery spots on the body, which are distinctive, and to which attention was drawn by Annandale and Rao, appear on the third day after hatching, by which time the external gills are lost and the labial teeth visible. Development is rapid and the young toad on metamorphosis measures less than 10 mm. The young are light brown in colour with darker marblings centred with pale pink. These colours are lost by the time they attain a size of 30 mm.

This species is listed as *Bufo andersoni* in Boulenger's Fauna (p. 504). Annandale (*Rec. Ind. Mus.* 3: 283-284, 1909) held that this was identical with *stomaticus* Lutken described from an unknown locality in 1862.

It has been recorded from Arabia and over the whole of northern peninsular India, as also Rajshahi in Eastern Bengal, Purneah and Lucknow. In *JBNHS,* 27: 126, 1920, Narayan Rao described a new race *peninsularis* based on 2 specimens from Coorg. The differences were relative and not confirmed by Boulenger. The examination of 23 fresh specimens (12 males and 11 females) from Bombay ranging from 34 mm. to 59 mm. in length confirms that the differences between *stomaticus* and *andersoni,* as also those said to separate the southern form *peninsularis,* are all covered by the individual variations exhibited in this species.

C/O MESSRS FAIZ & CO.,
75, ABDUL REHMAN STREET,
BOMBAY 3

HUMAYUN ABDULALI

NATURAL HISTORY MUSEUM,
DARJEELING, WEST BENGAL.
*June* 28, 1956.

J. C. DANIEL,
*Curator*

## 23. ON A COLLECTION OF FISH FROM ASSAM

(*With a text map*)

The State of Assam lies on the north-eastern border of Bengal and forms the north-east frontier State of India. It comprises the Valley of the Brahmaputra and the mountainous watershed which feeds the river and its tributaries. Except on the west it is shut in by jungle-covered ranges or lofty mountains. From east to west it is traversed by the main Brahmputra River, and the strips of land along each bank of the great river are intersected by numerous minor streams. From the geographical point of view the Assam Plateau cannot be affiliated to the Peninsula, but geologically there would appear to be a proper connection since the prevailing rocks are closely similar. The study of the fish fauna of the region shows several interesting features, suggesting that it served as the route for the Malayan element to migrate into Peninsular India, during the Tertiary era.[1]

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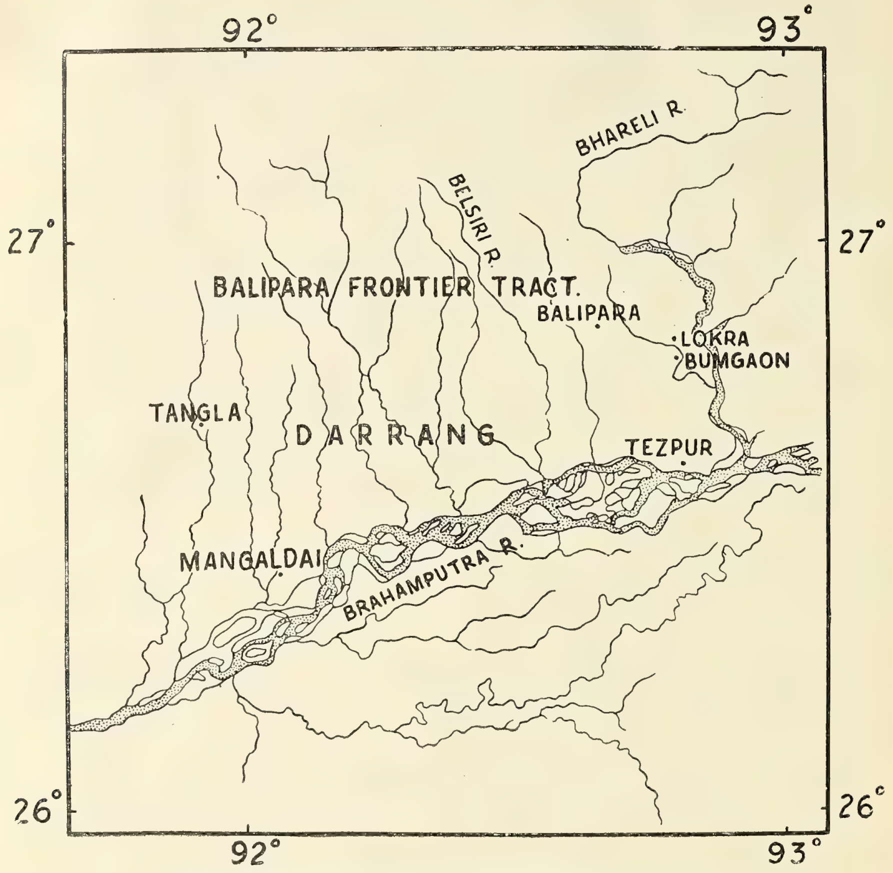
[1] Hora, S.L., *Proc. Nat. Inst. Sci. India*, XV (8) : 309-310.

In November 1939 Drs. B. Prashad and S. L. Hora visited Darrang District and Balipara respectively and made a collection of fish in rivers, streams, ponds, borrowpits, lakes etc. of this region of Assam. The largest river in this region is the Bhareli, which rises in the Aka Hills and enters the district just to the north of Bhalukpong. It first flows east between the ranges of the hills and then turns sharply to the south and takes a tortuous course to the Brahmaputra, which it joins about 7 miles east of Tezpur town. In addition to the Bhareli River there are numerous other rivers which carry off the drainage of the hills into the Brahmaputra. Besides these, there are a few bhils (lakes) like Kenduguri Bhil and Soni Gaon Bhil of fairly large size. These bhils are shallow pools of no great extent which collect in depressions in the lower parts of the district generally near the Brahmaputra. Almost the whole of the region consists of alluvial deposits of clay and sand in varying proportions, ranging from pure sand near the Brahmaputra to a clay so stiff that it is quite unfit for cultivation.


92°
93°
27°
27°
BHARELI R.
BELSIRI R.
BALIPARA FRONTIER TRACT.
BALIPARA
LOKRA
BUMGAON
TANGLA
DARRANG
TEZPUR
MANGALDAI
BRAHAMPUTRA R.
26°
26°
92°
93°

Sketch map of the region in which collection was made.

In the collection under report, there are altogether 70 species and of these four, i.e., *Setipinna phasa* (Hamilton), *Nemachilus savona* (Hamilton), *Glyptothorax rebeiroi* (Hora) and *Doryichthys deocata* (Hamilton) have been recorded from this region for the first time. In the accompanying table, the species are listed with their respective places of collection in Assam, and their general distribution.

I am indebted to the late Dr. S. L. Hora, Director, Zoological Survey of India, for placing the material at my disposal and for his constant guidance and encouragement. My thanks are also due to Shri A. G. K. Menon, Assistant Zoologist, Zoological Survey of India, for helping me during the investigation.

| Name of species | Locality in Assam | Further Distribution |
|---|---|---|
| Family : NOTOPTERIDAE | | |
| 1. *Notopterus chitala* (Hamilton) | Mangaldai (Darrang Dist.). | India to Malay Archipelago. |
| 2. *Notopterus notopterus* (Pallas) | Mangaldai. | India, Burma and further East. |
| Family : ENGRAULIDAE | | |
| 3. *Setipinna phasa* (Hamilton) ... | Tezpur Fish Market (Darrang Dist.). | Orissa, Bengal, Cachar and Burma. |
| Family : CLUPEIDAE | | |
| 4. *Gadusia chapra* (Hamilton) ... | Mangaldai & Tezpur Fish Market. | Widely distributed in India ; absent south of the Kistna. |
| Family : CYPRINIDAE | | |
| Sub-family : ABRAMIDINAE | | |
| 5. *Chela bacaila* (Hamilton) ... | Tangla (Darrang Dist.) | Throughout India (except Malabar) and Burma. |
| 6. *Chela gora* (Hamilton) ... | Tangla & Tezpur Fish Market. | Sind, throughout Northern India and Assam. |
| Sub-family : RASBORINAE | | |
| 7. *Barilius bola* (Hamilton) ... | Mangaldai & Tezpur Fish Market, Tangla. | Orissa, Bengal, North West Province, Assam and Burma. |
| 8. *Barilius barila* (Hamilton) ... | Lokra (Balipara Frontier Tract). | Delhi, North West and Central Provinces, Bengal, Orissa and Lower Assam. |
| 9. *Barilius bendelisis* (Hamilton) | Lokra | Throughout India, not recorded from coast of Malabar. |
| 10. *Barilius tileo* (Hamilton) | Tangla. | Bengal and Assam. |
| 11. *Danio (Danio) dangila* (Hamilton) ... | Lokra. | Bengal, Bihar, Himalayas at Darjeeling, also the hills above Akyab. |

| Name of Species | Locality in Assam | Further Distribution |
|---|---|---|
| Sub-family: RASBORINAE—(*cont.*) | | |
| 12. *Danio (Danio) devario* (Hamilton) ... | Tangla. | Throughout India. |
| 13. *Danio (Brachydanio) rerio* (Hamilton) ... | Tezpur. | Throughout India and Burma. |
| 14. *Esomus danricus* (Hamilton) | Tezpur and Mangaldai. | India, Ceylon, Burma and the Nicobars. |
| 15. *Rasbora elanga* (Hamilton) ... | Mangaldai and Tezpur. | Bengal, Assam and Burma. |
| 16. *Rasbora rasbora* (Hamilton) | Lokra. | India, Assam, Burma and Penang. |
| Sub-family: CYPRININAE | | |
| 17. *Amblypharyngodon mola* (Hamilton) | Tezpur Fish Market and Tangla. | Throughout India (except Malabar) and Burma. |
| 18. *Aspidoparia morar* (Hamilton) | Tezpur Fish Market. | All over Northern India, Assam and Burma. |
| 19. *Puntius chagunio* Hamilton ... | Tangla and Lokra. | Bengal, Bihar, Assam, NW. Provinces and Punjab. |
| 20. *Puntius chola* Hamilton ... | Lokra. | Throughout India and Burma to Mergui. |
| 21. *Puntius phutunio* Hamilton ... | Mangaldai. | Ganjam, Orissa and throughout Bengal and Burma. |
| 22. *Puntius sarana* Hamilton ... | Tezpur Fish Market, Mangaldai, Tangla and Lokra. | India and Burma. |
| 23. *Puntius sophore* Hamilton ... | Tangla and Mangaldai. | Throughout India, and Burma as high as Mandalay. |
| 24. *Puntius ticto* Hamilton ... | Tezpur Fish Market, Tezpur and Tangla. | Ceylon, India, Burma and also Siam. |
| 25. *Puntius tetrarupagus* McClelland | Tangla and Mangaldai. | Orissa, Bengal, Assam, NW. Provinces, Punjab and Sind, also the Deccan. |
| 26. *Puntius titius* Hamilton ... | Lokra. | Orissa, Bengal, Assam, NW. Provinces, Punjab and Sind. Also the Deccan. |
| 27. *Catla catla* (Hamilton) ... | Tezpur Fish Market. | India, Burma and Siam. |
| 28. *Cirrhina mrigala* (Hamilton) | Mangaldai. | India and Burma. |
| 29. *Cirrhina reba* (Hamilton) ... | Tezpur Fish Market and Mangaldai. | Throughout India. |
| 30. *Labeo angra* (Hamilton) ... | Tezpur Fish Market. | Assam, Bengal, Orissa and Burma. |
| 31. *Labeo bata* (Hamilton) ... | Tangla, Tezpur Fish Market and Lokra. | Orissa, Bengal and Assam. |
| 32. *Labeo boga* (Hamilton) ... | Tezpur Fish Market and Lokra. | Rivers of the Gangetic Provinces, Madras and Burma. |
| 33. *Labeo calbasu* (Hamilton) ... | Mangaldai. | India and Burma. |
| 34. *Labeo dero* (Hamilton) ... | Tangla and Lokra. | Delhi, Sind, Bengal and Assam. |
| 35. *Labeo dyocheilus* (McClelland) | Lokra. | Sind, Bengal and Assam. |
| 36. *Labeo gonius* (Hamilton) ... | Mangaldai and Tangla. | India and Burma; absent south of the Kistna. |
| 37. *Lobeo rohita* (Hamilton) ... | Mangaldai. | India and Burma. |

| Name of Species | Locality in Assam | Further Distribution |
|---|---|---|
| Family : COBITIDAE | | |
| 38. *Lepidocephalus guntea* (Hamilton) | Tezpur and Tangla. | Ceylon, India and Burma. |
| 39. *Nemachilus botia* (Hamilton)... | Tangla and Lokra. | Ceylon, India and Burma. |
| 40. *Nemachilus savona* (Hamilton) | Lokra. | Darjeeling Himalayas. |
| Family : CLARIIDAE | | |
| 41. *Clarias batrachus* Linnaeus ... | Tezpur Fish Market. | India, Burma and further east. |
| Family : HETEROPNEUSTIDAE | | |
| 42. *Heteropneustes fossilis* (Bloch) | Mangaldai and Tezpur Fish Market. | Ceylon, India, Burma and Cochin-China. |
| Family : SILURIDAE | | |
| 43. *Callichrous macropthalmus* (Blyth) | Tezpur Fish Market. | Madras, Assam and Burma. |
| 44. *Wallago attu* (Bloch and Schneider) | Mangaldai and Tezpur Fish Market. | India, Burma and Ceylon. |
| Family : CHACIDAE | | |
| 45. *Chaca chaca* (Hamilton) ... | Lokra. | Bombay, Brahmaputra, Ganges and Irrawady. |
| Family : SCHILBEIDAE | | |
| 46. *Ailia coila* (Hamilton) ... | Mangaldai and Tezpur Fish Market. | Throughout India. |
| 47. *Clupisoma garua* (Hamilton) | Mangaldai. | Sind, all over Northern India, Assam and Burma. |
| 48. *Eutropiichthys vacha* (Hamilton) | Mangaldai and Tezpur Fish Market. | Punjab, Sind, Bengal, Orissa, Burma and Siam. |
| Family : BAGRIDAE | | |
| 49. *Mystus* (*Mystus*) *cavasius* (Hamilton) | Mangaldai, Tangla and Tezpur Fish Market. | Throughout India and Burma. |
| 50. *Mystus* (*Osteobagrus*) *seenghala* (Sykes) | Tezpur Fish Market. | Punjab, U. P., Delhi, Bengal and Burma. |
| 51. *Mystus* (*Mystus*) *vittatus* (Bloch) | Tezpur Fish Market. | Throughout India, Burma, Siam and Ceylon. |
| Family : SISORIDAE | | |
| 52. *Glyptothorax rebeiroi* (Hora) | Tangla. | Tista drainage, Darjeeling Himalayas, Kosi River, Bihar and Rihand River, Vindhya Pradesh. |
| 53. *Gagata viridescens* (Hamilton) | Tezpur Fish Market. | Rivers of Bengal, Delhi, Assam, Poona in the Deccan. |

| Name of Species | Locality in Assam | Further Distribution |
|---|---|---|
| Family : Cyprinodontidae | | |
| 54. *Panchax panchax* (Hamilton) | Mangaldai. | India, Assam and Burma. |
| Family : Mugilidae | | |
| 55. *Mugil corsula* (Hamilton) | Tezpur Fish Market. | Common in the larger rivers of India. |
| Family : Belonidae | | |
| 56. *Xenentodon cancila* (Hamilton) | Tezpur Fish Market. | Ceylon, India, Burma and further east. |
| Family : Syngnathidae | | |
| 57. *Doryichthys deocata* (Hamilton) | Tangla. | Bengal and Bihar. |
| Family : Channidae | | |
| 58. *Channa gachua* (Hamilton) | Tangla. | India, Burma, Ceylon and the Andamans. |
| 59. *Channa marulius* (Hamilton) | Tangla. | Ceylon and India to China. |
| 60. *Channa punctatus* (Bloch) | Mangaldai and Tangla. | Throughout India, Burma and Malaya. |
| Family : Anabantidae | | |
| 61. *Anabas testudineus* (Bloch) | Mangaldai and Tangla. | Ceylon, India, Burma and further east. |
| Family : Percidae | | |
| 62. *Ambassis nama* (Hamilton) | Tezpur Fish Market. | India and Burma. |
| 63. *Ambassis ranga* (Hamilton) | Tezpur Fish Market, Tangla and Lokra. | India, Burma and Siam. |
| Family : Osphronemidae | | |
| 64. *Colisa chuna* (Hamilton) | Tezpur and Tangla. | Bengal and Assam. |
| 65. *Colisa fasciatus* (Bloch and Schneider) | Mangaldai, Tangla and Tezpur. | India and Burma. |
| Family : Gobiidae | | |
| 66. *Glossogobius giuris* (Hamilton) | Tezpur Fish Market. | India, Burma and further east. |
| Family : Nandidae | | |
| 67. *Badis badis* (Hamilton) | Lokra. | India and Burma. |
| 68. *Nandus nandus* (Hamilton) | Mangaldai and Tezpur Fish Market. | India, Burma and Siam. |

| Name of Species | Locality in Assam | Further Distribution |
|---|---|---|
| Family : MASTACEMBELIDAE | | |
| 69. *Mastacembelus pancalus* (Hamilton) ... | Tangla. | Large rivers of India and localities near sea. |
| 70. *Rhynchobdella aculeata* (Bloch) ... | Tezpur Fish Market. | Common in the deltaic regions of N. India. |

The majority of the species are fairly well known and widely distributed and do not call for any special remarks. Some remarks are, however, made on the following:

### **Setipinna phasa** (Hamilton)

1822. *Clupea phasa*, Hamilton, Fish. Ganges, pp. 241, 382, pl. ii, fig. 72.
1878. *Engraulis telara*, Day, Fish. India, p. 627, pl. C1 viii, fig. 2.
1953. *Setipinna phasa*, Misra, *Rec. Ind. Mus.*, L, p. 384, fig. 6a.

In the collection under report *Setipinna phasa* is represented by a single specimen, about 11·2 inches in total length, purchased from Tezpur Fish Market.

It is distributed in Orissa, Bengal, Cachar and Burma.

### **Nemachilus savona** (Hamilton)

1822. *Cobitis savona* Hamilton, Fish. Ganges p. 357.
1935. *Nemachilus savona* Hora, *Rec. Ind. Mus.*, XXXVII, p. 56, pl. iii, figs. 3 and 4.

A single specimen of *N. savona* was caught in Bhareli River about 2 miles below Lokra.

Hora gives the distribution of the species as 'the foot of the Darjeeling Himalayas at Sevoke and Siliguri'.

### **Glyptothorax rebeiroi** (Hora)

1921. *Laguvia rebeiroi*, Hora, *Rec. Ind. Mus.*, XXII, p. 741, pl. xxix, fig. 3.
1954. *Glyptothorax rebeiroi* Menon, *Rec. Ind. Mus.*, LII, p. 27.

Hora, in his paper referred to above, distinguished *Laguvia* from *Glyptothorax* only in the possession of humerocubital and scapular processes, the presence of bony tubercles on the sides of the body and in the absence of a well marked adhesive thoracic apparatus. Menon, on examination of the collections of *Glyptothorax*, proposed to merge *Laguvia* Hora into the synonymy of *Glyptothorax* Blyth.

In Dr. Hora's collection there are 8 specimens of G. *rebeiroi* caught in streamlets of Tangla.

The distribution of the species is as follows: Tista drainage, Darjeeling Himalayas, Kosi River, Nepal, Himalayas, Morel River, Santal

Parganas and Kamala River, Darbhanga District; Bihar and Rihand River, Vindhya Pradesh.

**Doryichthys deocata** (Hamilton)

1822. *Syngnathus deocata* Hamilton, Fish. Ganges, pp. 114, 363.
1877. *Doryichthys deocata* Day, Fish. India, P. 680.

The only specimen under report was caught in streamlets of Tangla, Darrang Dist.

Day recorded the species from Bengal and Bihar.

ZOOLOGICAL SURVEY OF INDIA, K. L. SEHGAL.
CALCUTTA,
*December* 29, 1955.

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Menon, A. G. K. (1954): Further Observations on the Fish-Fauna of the Manipur State. *Rec. Ind. Mus.* LII: 21-26

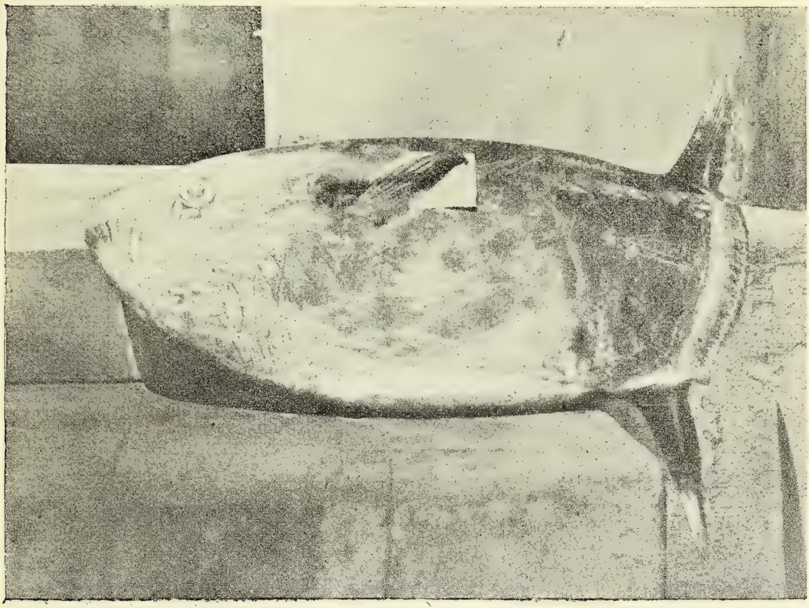
———, M. A. S. (1952): On a Small Collection of Fish from Manipur, Assam. *Rec. Ind. Mus.* L: 265-70.

## 24. A RECORD OF THE SUN-FISH, *RANZANIA TRUNCATA* (RETZIUS) NEAR BEYPORE, MALABAR COAST

(*With a photo*)

On 14 February 1956 one female specimen of *Ranzania truncata* was captured by the local fishermen from the shallow waters near Beypore, seven miles south of Calicut. It showed all the typical characters of the species, such as oblong body twice as long as deep, smooth and tessellated skin and truncate caudal. The fish measured 61 cm. in length and 30 cm. in width. The dorsal fin was 17 cm. high and 6.5 cm. at base; and had 17 rays. Anal was 15 cm. long and 6 cm. at base; and had 18 rays. Pectoral was 10.5 cm. high and 3 cm. at base; and had 13 rays. Eyes were 3.5 cm. in diameter. Skin was 1 cm. thick. Mouth-opening was terminal, oval in shape and 3.5 × 1.5 cm. in size. Alimentary tract was a straight tube 115 cm. in length, and contained digested mucilaginous matter. Ovary was single-lobed, 22 × 6.5 cm. in size and 220 grams in weight; and contained 14 lakhs eggs.

This is a new record of this oceanic fish in this coastal area. It is probable that the fish had followed one of the ocean-going vessels that frequently call at Beypore port and then drifted towards the shore. The specimen is kept in the museum of the Marine Biological Station, West Hill.



Marine Biological Station,
West Hill, Malabar,
*February* 24, 1956.

P. I. CHACKO
M. J. MATHEW

[Occurrence of members of the family Mollidae along the coast of India is rare. From Bombay, a specimen of *Masturus lanceolatus* was recorded for the first time by Dr. Kulkarni (*JBNHS*, 51: 940, 1953). The present record of the Sun fish, *Ranzania truncata*, from the Malabar Coast near Beypore, appears to be the second record of its occurrence on the West Coast of India.—Eds.]

## 25. OCCURRENCE OF THE COPEPOD PARASITE *LERNEA ELEGANS* ON *OPHICEPHALUS STRIATUS* FISH FRY IN MYSORE

A bath of 580 *Ophicephalus striatus* fish fry of 1″ size were collected on 7-6-1949 in the Palar River below the Ramasagara tank. The fry were transferred to a nursery pond in the Markandeya Fish Farm in Kolar district. On 11-7-1949, 100 fish fry from this batch were collected to record their growth in length and weight. While doing so, it was noticed that over 60% of the fish fry were infested with external parasites in the region of the pectoral, pelvic and dorsal fins. On dislodging these parasites, it was noticed that the parasites had firmly fixed themselves in the flesh of the fish with the help of an anchor-like appendage. The anchor was fleshy in colour while the body of the parasite was dark, and near the free end there were two bags containing eggs of the parasite. On the body of the parasite, there were green filamentous growths which were later identified as colonies of *Vorticella*. Mortality due to this parasitic infestation was negligible. The parasites were later identified as copepod parasites belonging to the species *Lernea elegans*. The infestation of the parasite was gradually reduced by plucking out at each reading, so much so that by the time the fish had grown to 3.5″ the parasites were completely eliminated.

Of the thousands of fish fingerlings handled by us, both in Kolar and other districts, this is the only record of the occurrence of copepod parasites on fish fingerlings in Mysore State.

FISHERIES SECTION,
DEPARTMENT OF ANIMAL HUSBANDRY,
GOVERNMENT OF MYSORE, BANGALORE,
*November 18*, 1955.

H. D. R. IYENGAR
K. VENKATESH

## 26. BIOLOGICAL CONTROL OF SUBMERGED AQUATIC VEGETATION IN POND FISHERIES BY CULTURE OF 'KATLI' [*BARBUS* (*LISSOCHILUS*) *HEXAGONOLEPIS*], A HILL STREAM SPECIES OF FISH OF DARJEELING DISTRICT (WEST BENGAL)

In the management of pond fisheries, one of the major problems which stands in the way of the fish farmers of West Bengal is the effective eradication of unwanted water weeds and their control. Up till now, no chemical or mechanical methods are known which can be effectively used for the purpose. Series of investigations were carried out in the laboratory as well as in the field stations of the Directorate with regard to the use of chemicals like sodium arsenite, copper sulphate, nigrosine, 2-4-D etc. for the purpose, but no suitable solution to the problem could be found, in view of the fact that the effective chemicals were either too expensive or too poisonous in character, which restricted their use. Various forms of mechanical contrivances were also tried but, in view of tender nature of the vegetation, no material success could also be achieved in this respect.

The F. A. O. Expert, who was assigned for advising the State Government in the matter of inland fisheries development, suggested liberation of exotic fish like *Tilapia mossambica* and *Puntius javanicus* in West Bengal water for the purpose. But experiments carried out in different laboratories of India on the food and feeding habits of *Tilapia mossambica* indicate that, at certain stages, it may be inimical to the fry of Indian major carps and, as such, introduction of this species in Indian waters cannot be encouraged until further information is available.

It was subsequently observed that the hill stream species of fish 'Katli' was purely herbivorous in character and ate up readily the leaves of quite a good number of hill shrubs given to it. On the basis of this observation, a consignment of about 90 fingerlings of 'Katli' was brought by air from Kalimpong (Darjeeling) in October 1953, after collecting the same from the river Ryang with the idea of studying:

(i) how far its herbivorous character could be utilised for effecting biological control of unwanted submerged aquatic vegetation in pond fisheries;

(ii) how far it could be acclimatised to withstand higher atmospheric temperature in the plain;

(iii) its effect on the culture of Indian major carps; and

(iv) possibility of its breeding in confined waters in the plain.

## EXPERIMENTAL

Ninety fingerlings, measuring between 2.5 to 4 inches, were liberated in a specially constructed tank in the departmental fish farm near Calcutta. The size of the tank was 720 sq. ft. having 5 ft. depth. Subsequent to liberation of the fingerlings, the tank was also stocked with an equal number of Rohu (*Labeo rohita*), Catla (*Catla catla*) and Mrigal (*Cirrhina mrigala*), sizes varying from 2.3 to 2.7 inches. Prior to liberation of the fingerlings, the tank was planted with aquatic weeds like *Vallisneria, Hydrilla* and *Ceratophyllum*. Along with the field investigations, aquarium experiments were also conducted with the types of vegetation mentioned above. General performance of the liberated fingerlings of different species, their growth rates and effect on the vegetation were kept under close observation.

## DISCUSSION

From the results obtained so far, it has been found that neither any distressed condition was observed in 'Katli' even at an atmospheric temperature of 110°F., nor was there any mortality, although at the time of collection of fingerlings from the hill streams the temperature was about 56°F. Moreover, although there was material difference in the water qualities of the river Ryang and of the farm tank, as may be seen from the undernoted analytical results, no change was noticeable in the locomotory activities of the fish and its physiological condition at any stage.

After a period of about 7 months, settled sewage water was introduced into the tank in regulated doses but no adverse effect was noticed.

Both in aquarium and field experiments it was found that 'Katli' fingerlings used to feed on all the three types of vegetation noted and its herbivorous character could be effectively utilized for eradication of unwanted submerged water weeds with which the West Bengal fish farmers are mostly concerned. Further experiments for assessing the number of fingerlings needed under varying concentration of vegetation are in progress.

| | *Water quality of the river Ryang* | *Water quality of the farm tank* |
|---|---|---|
| pH ... | 6·9 | 8·6 |
| Alkalinity as $CaCo_3$ ... | 21 ppm. | 105 ppm. |
| Dissolved oxygen ... | 5·1 ,, | 6·6 ,, |
| Salinity as chlorine ... | 6 ,, | 520 ,, [1] |
| Dissolved phosphate as $P_2O_5$ ... | 0·4 ,, | 4·5 ,, |
| Saline ammonia as $N_2$. | 0·48 ,, | 1·4 ,, |
| Dissolved nitrate as $N_2$. | Trace | 0·04 ,, |
| Dissolved nitrite as $N_2$. | Nil | 0·4 ,, |

From the study of comparative growth rates of 'Katli' and the three species of Indian major carps, it appeared that Katli had no inimical effect on the growth rate of major carps, and as such their mixed culture seemed to be promising. The undernoted results on their length measurements would show that growth rate of 'Katli' compared favourably with that of Rohu and Mrigal. Catla, however, appeared to have grown faster.

*Length indicated in inches.*

| | *Observed in October* 1953. | *Observed in April* 1954. |
|---|---|---|
| 'Katli' ... | 2·5 to 4·5 | 7·2 to 9·1 |
| Rohu (*Labeo rohita*) ... | 2·3 to 4·7 | 7·4 to 9·5 |
| Mrigal (*Cirrhina mrigala*) ... | 2·4 to 4·3 | 6·9 to 9·0 |
| Catla (*Catla catla*) ... | 2·5 to 4·7 | 8·6 to 13·1 |

The fingerlings were kept under close observation to see their possibility of breeding in confined water in the plains.

According to Hora and Nazir Ahmed (1946) as well as Langdale Smith (1944) 'Katli' breeds in summer (August to September). But in our case, although one summer has passed since the observations started, neither any egg-bearing sign in any of the female 'Katli' could be noticed nor any spawn or fry detected in the tank. It may be that by that time the females did not attain sufficient maturity necessary for spawning. In a note on Langdale Smith's observations on the breeding habits of 'Katli', Hora (1944) stated: 'It is now clear to us that the small size of breeding males, 4″ to 7″ in length, found by us in the Rambi, Ryang and Tista rivers is not due to any adverse effect of the effluent from the Cinchona Factory at Mungpoo but is the natural size at which the fish begins to breed.' Hora and Nazir Ahmed (1943) observed that males become fully mature when they are only 91 mm. It was also observed by the authors that whereas males of 91 mm. in length had attained maturity, females of 195 mm. in length showed that the eggs were just forming in the ovary. According to Hora and Nazir Ahmed (1946), whereas males mature when they are small in size, the females rarely attain maturity under 9 inches in size.

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[1] This large difference is due to the fact that the farm water was sewage-fed and therefore of very high salinity.

From the observations made by the above workers, failure of 'Katli' to breed in the farm tank up to September 1954 was perhaps due to insufficient maturity in female specimens. However, further observations in this regard are in progress.

## SUMMARY

1. The hill-stream species of fish 'Katli' [*Barbus* (*Lissochilus*) *hexagonolepis*] was found to feed on submerged aquatic weeds like *Valisneria, Hydrilla* and *Ceratophyllum.*

2. No change was observed in the locomotory activities of the fish and its physiological condition under the altered climatic conditions of the plains.

3. The fish was found to have no inimical effect on the growth rate of Indian major carps (Rohu, Catla and Mrigal) and as such their mixed culture seemed to be promising.

4. During the period under report (October 1953 to September 1954) no symptom was observed in any of the fish indicating possibility of its breeding in confined waters of the plains.

## ACKNOWLEDGEMENT

Our best thanks are due to the Government of West Bengal for providing the facilities and funds for carrying out the investigations.

TECHNOLOGICAL LABORATORY,
DIRECTORATE OF FISHERIES, K. C. SAHA
GOVERNMENT OF WEST BENGAL. D. P. SEN

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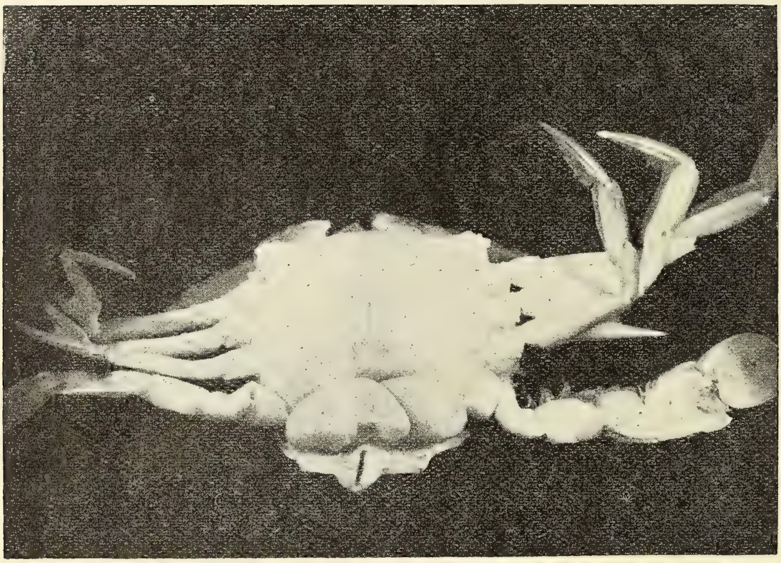
Hora, S. L. (1944): *Jour. Bengal Nat. Hist. Soc.* **xix**: 90.

Hora, S. L. & Nazir Ahmed (1946): Culture of Katli *Barbus* (*Lissochilus*) *hexagonolepis* McClelland, in the Darjeeling Himalayas, Fishery Development Pamphlet No. 2, Government of Bengal.

Langdale Smith, W. K. (1944): A note on the breeding habits of 'Katli' *Barbus* (*Lissochilus*) *hexagonolepis* McClelland; *Jour. Beng. Nat. Hist. Soc.* **xix**: 89.

## 27. ON THE OCCURRENCE OF THREE *SACCULINA* PARASITISING THE EDIBLE CRAB *NEPTUNUS SANGUINOLENTUS*

(*With a photograph*)



The crab showing the three parasites attached to its abdomen.

The record of a single host crab parasitised by more than one *Sacculina* of the same species seems to be very rare. George[1] recorded a case of a female crab parasitised by two forms belonging to the genus *Sacculina* which he provisionally identified as sp. *Rotundata.* Further, the usual site of attachment of *Sacculina externa* is given as the junction of the thorax and abdomen.[2]

In a collection of 193 crabs (*Neptunus sanguinolentus*) caught off the Ramnad coast on 6 February 1956, the authors noticed that 169 were parasitised by the genus *Sacculina.* It was observed that out of the 169 infected ones, 73 showed the presence of two parasites, while 5 of them had three each, attached close behind one another to the inner face of the abdomen. Details of a few typical forms are given in the table.

George[1] noticed that the place of attachment of the forms he studied was the 3rd and 4th abdominal segments. It is evident from the table that there is no regularity regarding the exact point of emergence of *Sacculina externa* on the abdomen. It was very noteworthy that all the parasitised forms in our collection have been females. From the point of the number of parasites infesting a single host, this collection

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[1] George, M. J. (1948) : *Proc. Ind. Acad. Sci., B.* : 207.

[2] Smith, G. (1906) : Fauna und Flora des Golfes Von Neapel : 123.

TABLE SHOWING THE DETAILS OF THE HOST AND PARASITE

| Sex of crab | Breadth of carapace of crab in mm. | Number of parasites | Measurements of the parasites | | Site of attachment on the segment of abdomen | Nature of abdominal appendage of host |
|---|---|---|---|---|---|---|
| | | | Length in mm. | Breadth in mm. | | |
| Female | 65 | 3 | 1. 12<br>2. 13<br>3. 13 | 23<br>15<br>20 | Junction of abdomen and thorax<br>2<br>3 | absent |
| Do. | 62 | 3 | 1. 15<br>2. 10<br>3. 12 | 20<br>14<br>18 | 1–2<br>2–3<br>1–2 | absent |
| Do. | 70 | 3 | 1. 16<br>2. 12<br>3. 14 | 22<br>15<br>18 | 1–2<br>3<br>3 | absent |
| Do. | 64 | 3 | 1. 12<br>2. 10<br>3. 8 | 21<br>15<br>12 | 3<br>3<br>3 | absent |
| Do. | 68 | 3 | 1. 12<br>2. 11<br>3. 12 | 18<br>21<br>16 | 2<br>2–3<br>3 | absent |
| Do. | 67 | 2 | 1. 16<br>2. 9 | 28<br>10 | 1<br>3–4 | absent |
| Do. | 67 | 2 | 1. 10<br>2. 7 | 18<br>11 | 3<br>2 | Reduced |
| Do. | 66 | 2 | 1. 21<br>2. 12 | 34<br>21 | 2<br>3–4 | absent |
| Do. | 62 | 2 | 1. 14<br>2. 10 | 26<br>18 | 2–3<br>4 | absent |
| Do. | 60 | 2 | 1. 15<br>2. 13 | 26<br>19 | 2–3<br>3–4 | absent |
| Do. | 60 | 2 | 1. 12<br>2. 16 | 18<br>23 | 2<br>3–4 | absent |
| Do. | 59 | 2 | 1. 18<br>2. 9 | 24<br>12 | 3<br>3 | absent |
| Do. | 57 | 2 | 1. 15<br>2. 12 | 24<br>15 | 3<br>3 | absent |
| Do. | 52 | 2 | 1. 13<br>2. 11 | 22<br>14 | Junction of thorax and abdomen<br>3–4 | absent |

seems to be remarkable since more than 40 per cent of the crabs showed the presence of more than one parasite.

A detailed study of the life history and effects of the parasite on the host is in progress.

Thanks are due to Prof. J. Samuel Raj for facilities given.

DEPARTMENT OF ZOOLOGY,
ALAGAPPA COLLEGE, KARAIKUDI,
*February* 18, 1956.

N. BALAKRISHNAN NAYAR,
O. N. GURUMANI.

## 28. EXTENSION OF RANGE OF THE FRESHWATER CRAB *PARATELPHUSA* (*OZIOTELPHUSA*) *HYDRODROMUS* (HERBST)

In November 1954, Mr. Humayun Abdulali collected some freshwater crabs at Mahableshwar, 4,500 ft. (Satara District, Bombay State). One of these has been identified as *Paratelphusa* (*Oziotelphusa*) *hydrodromus* (Herbst) at the Taraporevala Marine Biological Station, Bombay, and confirmed at the Indian Museum, Calcutta. The characteristics of this species are the strong convexity of the carapace, separation of the free edge of the 'front' proper from the antennular edge of the front, and by the post-orbital crests ending well in the rear of the small lateral epibranchial teeth.

Alcock[1] gives the distribution of this crab as Bengal (Ranigunj, Barabhoom, Calcutta), Allahabad, Orissa, and various localities in South India (Pondicherry, Ellore, Madras, Madura, Travancore and Calicut). Chopra and Tiwari[2] (1947) have subsequently recorded it from Patna (Orissa). Pillai[3] describes this crab 'as a common species all along the west coast of India and the Madras Presidency'. On inquiry it transpires, however, that his statement is based on Alcock's records from Pallode and Shenkottah (both places in the southernmost part of the Western Ghats in Travancore), and the crab was so far not recorded, although so referred to by Pillai, north of Calicut along the west coast of India. The present record, therefore, constitutes a considerable extension of the known range of this species.

TARAPOREVALA AQUARIUM,
BOMBAY 2,
*April* 4, 1956.

B. F. CHHAPGAR

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[1] Alcock, A. (1910): *Paratelphusa* (*Oziotelphusa*) *hydrodromus*, Cat. Ind. Dec. Crust. part I, Brachyura, pp. 97-100, pl. xiii, fig. 60.

[2] Chopra, B. & Tiwari, K. K. (1947): *Paratelphusa* (*Oziotelphusa*) *hydrodromus*, *Rec. Ind. Mus.* **xlv**: 214.

[3] Pillai, N. Krishna (1951): *Paratelphusa* (*Oziotelphusa*) *hydrodromus*, *Bull. Central Research Institute, University of Travancore, Trivandrum* II, No. 1, series C, p. 17.

## 29. MITES FROM THE GILLS OF THE UNIO, *ANODONTA MARGINALIS*

In course of normal dissections of the common fresh water mussel, *Anodonta marginalis*, presence of mites in the gills has been recorded. The mussels were collected in the month of February 1956 from the ponds near about Calcutta. Almost all the specimens examined were found to be infected with the mites in varying extent. The number of mites in the gills ranged from two to twenty-five. They were found to occupy the spaces between the lamellae of the gills.

The mites appear to belong to the genus *Tombidium*. They are pale brownish in colour and are somewhat oval in outline, and all the walking legs are hairy. The chelicerae are simple hook-like structures and gradually taper at the outer extremity.

Body length from tip to tip (including the mouth parts) varies between .708 to .712 mm. The breadth of the body between the 2nd and 3rd leg is between .531 to .540 mm. The average length of the legs is 6.49 mm.

It would be very interesting to study the pathological implications on the gills due to the presence of these mites. Incidentally, in the present case no visible change in the gills was apparent.

ENTOMOLOGY LABORATORY,
ZOOLOGY DEPARTMENT,
UNIVERSITY COLLEGE OF SCIENCE, BARUNDEB BANERJEE
CALCUTTA,
*April* 25, 1956.

### REFERENCE

Shipley, A. E., Warburton, & others (1909): Cambridge Natural History Vol. 4.

## 30. SOME OBSERVATIONS ON THE ECOLOGY AND BEHAVIOUR OF THE COMMON INDIAN APPLE-SNAIL *PILA GLOBOSA* (SWAINSON)

(*With two text-figures*)

*Pila globosa* is studied as a type of Gastropoda in most of the Indian Universities. It is a freshwater and amphibious snail supposed to have descended from a marine ancestor which became established in estuarine waters. Lal and Saxena (1952) have demonstrated that this snail possesses uricotelic metabolism, hence its penetration in freshwater appears to be secondary. The present observations were made during a period of two years near the lakes of Chinhat, Kathota and Marayon in the vicinity of Lucknow (India), when the author had to collect the snails for studies on the blood and excretory constituents of *Pila globosa*.

For the greater part of the year *Pila globosa* aestivates under ground but appears in the water during the hot monsoon months of July and August in Northern India. This is the most vital part of the life of these snails. The nitrogenous excretory products accumulated during aestivation are unloaded (Saxena 1955). These snails feed and breed, as well, in this part of the year. *Pila globosa* is conspicuous by its strict terrestrial oviparity and complete cleidoic eggs. They have been observed to possess a strong instinct for laying eggs in dry protected corners, both in nature and under experimental conditions. According to Bahl (1928) oviposition in these snails can be delayed by preventing impregnated females from going out of water, but as soon as this check is removed oviposition begins. Experiments were performed to exhibit the intensity of this instinct and learning behaviour in these snails.

Experiment 1:

Two aquaria (*a*) and (*b*) of similar size, measuring 20″ × 12″ × 11″ were put in a glass chamber measuring 40″ × 27″ × 40″ as shown in figure 1. In aquarium (*a*) sufficient mud was placed so as to fill it up to one quarter of its height, while in (*b*) enough water was poured to fill it up to three quarters of its height. A few snails from the laboratory aquarium were placed in (*a*) and (*b*) aquaria. In the middle of July some snails were found pairing in aquarium (*b*), but oviposition could be observed in (*a*). It was interesting to observe that the snails in aquarium (*b*) learnt to climb up the inner wall of the aquarium and descend along the outer wall, and laid eggs in a dry corner of the glass chamber.

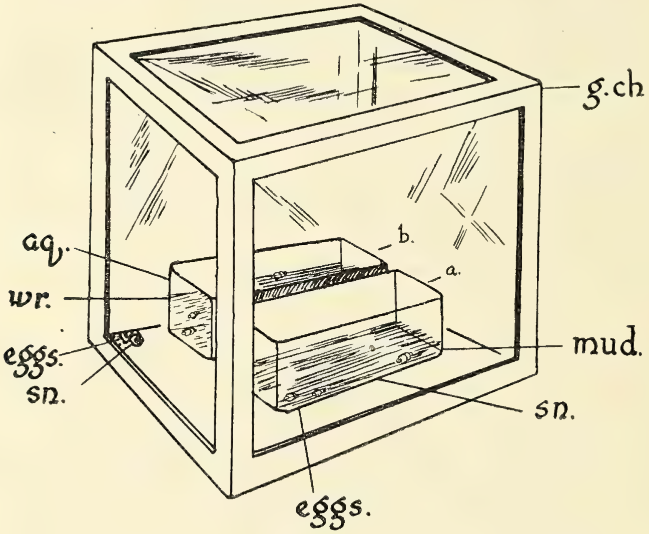

Fig. 1.

Experiment 2:

In another experiment two jars each measuring 6″ × 6″ × 14″ containing water were kept in the aquaria (*a*) and (*b*), other things being the same as in experiment 1. In this experiment the snails were kept in the glass jars. The snails from the jar contained in aquarium (*a*) came out and laid eggs on the mud in the corner of the aquarium, but remarkably enough the snails of the jar in aquarium (*b*) not only climbed out of the jar but also from the aquarium and laid eggs in the dry corner of the glass chamber. Not only is the judgment of the snails that the corner was the safest place noteworthy, but the posture of the animal during oviposition also was such as to avoid any chance of detection of the eggs by enemies. Figure 2.

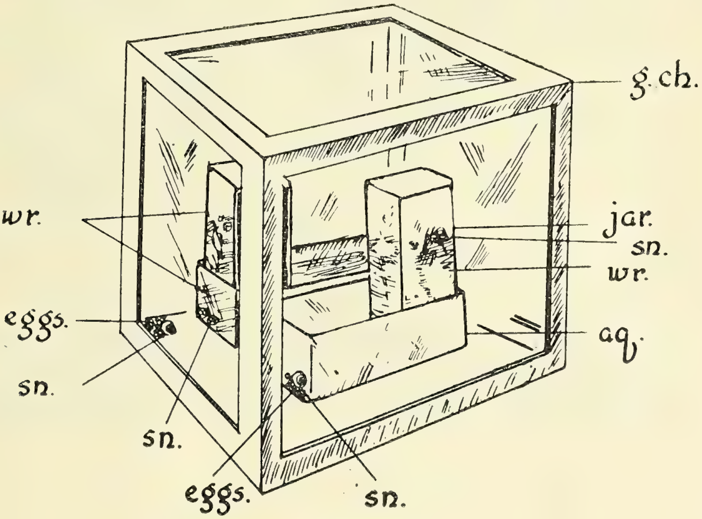

Fig. 2

aq., aquarium; g.ch., glass chamber; sn., snail; wr., water.

It is evident from these experiments that not only may there exist a natural rhythm to initiate oviposition in a particular part of the year, but also that these snails possess a strong instinct to lay eggs in dry protected places. These experiments on the other hand also amply illustrate the learning ability of *Pila globosa* to some extent.

*Pila globosa* appears to be incapable of tolerating even the summer and winter temperatures of 35°C. and 20°C. respectively, when accompanied by drought, hence the winter and the summer hibernations are clearly marked with a break in the rainy season. During hibernation the snail closely fits its operculum to the shell to make it an air-tight box, thereby eliminating any chances of water evaporation and for maintaining an optimum humidity inside the shell. When a snail is dug out from its hibernating burrow even in the hottest part of the year, the viscera of the animal appear as if quite drenched in water.

These snails usually occur near the banks of the lakes and seldom venture into deeper waters. However, it was sometimes possible to encounter a few snails in the deeper waters during the period they actually hibernate. It appears that they were thrown there by some mechanical agent, rather than went by themselves to lead a life of semi-hibernation. With the onset of summer, the water slowly evaporates from the ponds and the lakes leaving the banks still soft and muddy. At this time they bore their way into the ground by the aid of their foot which is the main organ employed for digging and progression. In ditches where all the water dries up, the snails burrow into the bottom mud. With the return of the rains they come out through the softening of the mud surrounding their burrows.

It is also worth mentioning that when some hibernating snails were maintained in the laboratory aquarium in summer with hydrilla twigs as food, they became active, fed and passed faeces. On the other hand during winter, they only respired by projecting their siphons above the water level in the aquarium, but neither ate nor passed faeces. These snails may be more intolerant to cold than to heat. They are mostly herbivorous and their food consists of aquatic plants like *Hydrilla* and succulent plants like *Vallisneria* and *Pistia*.

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF LUCKNOW, B. B. SAXENA
INDIA,
*February* 15, 1956.

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Lal, M. B. & Saxena, B. B. (1952): Uricotelism in *Pila globosa* (Swainson). *Nature.*, **170**: 95.

Saxena, B. B. (1955): Physiology of Excretion in the Common Indian Apple-snail, *Pila globosa* (Swainson). *Jour. Anim. Morph. Physiol., Bombay*. II (2). 87-95—December.

## 31. THE HORNED HELMET, *CASSIS CORNUTA* LINN.—AN ADDITION TO THE LIST OF MARINE GASTROPODS OF BOMBAY

(*With a photo*)

On 21 September 1955 one Shri Santosh Kumar, a diver, brought in a huge gastropod shell popularly called the Horned Helmet or Great Helmet-Shell or Elephant-Chank—*Cassis cornuta* Linn. (Cassididae) weighing 3 lb. which, he said, had been found at a depth of about 12 ft. in the Ballard Pier waters, Bombay.

This species has not been included in 'The Marine Mollusca of Bombay 1893' by James Cosmo Melvill and Alexander Abercrombie[1], or in the additional list of 25 new species by James Cosmo Melvill[2].

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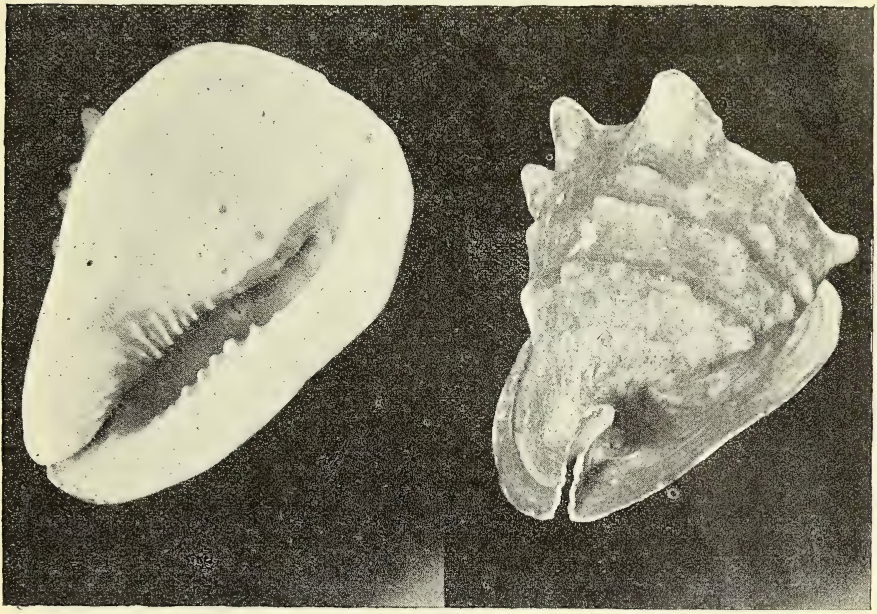
[1] *Mem. & Proc. Manchester Literary & Philosophical Soc.*, Vol. 7, 4th series.

[2] Vol. 7, series 4.

Neither does it appear in 'The Marine Gastropoda of Bombay' by T. V. Subrahmanyam, K. R. Karandikar and N. N. Murthi[1].



*Cassis cornuta* Linn. is the largest and the heaviest in the genus *Cassis* and has a wide distribution ranging from Mauritius to Japan. In Indian waters it has been recorded from a depth of 8-10 fathoms on the Pearl Banks in the Gulf of Mannar, and also from the Coromandel Coast, the Maldives and the Andamans. Its distribution, according to Reeve, is 'Moluccas, West Indies and Pacific Islands'. It is not mentioned in Schepman's Siboga Expedition Monograph.

There is only one specimen of this species weighing 3 lb. 15½ oz. in the collection of the Zoological Survey of India, obtained from the Andamans. The molluscan collections of the Government museums of Madras and Travancore do not include this species.

The present seems to be the first specimen from Bombay waters and is therefore worth recording. It was very kind of the diver, Santosh Kumar, to have presented this rare and interesting shell to the Museum.

NATURAL HISTORY SECTION,
PRINCE OF WALES MUSEUM OF W. INDIA,
BOMBAY,
*February* 29, 1956.

V. K. CHARI,
*Offg. Curator*

[James Hornell in 'Indian Molluscs', p. 22 says: 'The larger Helmet-Shells (Cassididae) are represented in India by two species, the Great Helmet-Shell *Cassis cornuta* and the Red Helmet *Cassis rufa*. The former is the largest and heaviest of Indian gastropods, its shell weighing several pounds . . . These great shells are rare and are usually found at a depth of eight to ten fathoms on the pearl banks in the Gulf of Mannar, and in the same depth in the neighbourhood of the Laccadives.'—Eds.]

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[1] *Journ. Univ. of Bombay,* Vol. xx, pt. 3, 1951.

## 32. OCCURRENCE OF THE FAIRY SHRIMP *STREPTOCEPHALUS DICHOTOMUS* (BAIRD 1860) IN MYSORE STATE

During November 1949, while trial nettings were being conducted in the rearing ponds in Markonahally Fish Farm, which is situated at an elevation of 2,600 ft. in Tumkur district, it was noticed that objects like shrimps were caught along with the fish in a cast net. When these were introduced in an aquarium, they began swimming upside down with a rhythmic movement of their appendages. The fishermen in the locality had never seen such shrimps. These were later identified as fairy shrimps *Streptocephalus dichotomus* (Baird 1860). They are being recorded for the first time from this area.

The water in the ponds was muddy and the fairy shrimps were in abundance for over a week. They then disappeared and all attempts to locate them up to this day have been futile.

Four years later, another instance of the appearance of the same species of fairy shrimps was recorded in Bikasipur tank in Bangalore district, about 10 miles from Bangalore, at an elevation of 3,200 ft. The tank is situated in a deep valley. A good number of them were taken out in a prawn net in September 1953. The water in the tank was muddy and contained no vegetation of higher aquatic type. These are the only two recorded instances of the occurrence of the Fairy Shrimp in Mysore State.

Fisheries Section,
Department of Animal Husbandry,
Goverment of Mysore, Bangalore,
*November* 18, 1955.

H. D. R. IYENGAR
N. BASAVAIAH

## 33. NOTES ON THE LEPIDOPTERA OF ASSAM—III FURTHER ADDITIONS TO THE INDIAN LIST AND OTHER NOTES

9. **Lycaenopsis ceyx cerima** Corbet

Since my last note on this species (Norman, 1953) I have identified a ♀ and taken another ♂ in the same locality (Sibsagar Dist., Upper Assam). The ♀ is new to science, and I give a detailed description.

♀, *Upperside, forewing*. Black border 1 mm. at base of costa increasing to 4 mm. at the apex; evenly 2 mm. along the termen. The rest of the forewing is dirty white, becoming darker towards the base, and overlaid with shining blue scales which are more obvious in a side light. The white is clearest in the basal two-thirds of spaces 2 and 3 and in the base of space 4. *Hindwing.* Dirty white below vein 7, spaces 4, 5 and 6 being purer white than the rest of the wing. Overlaid with blue scales as in the forewing. Equal sub-marginal black spots at ends of veins 1–6. *Underside.* Similar to the previously published description of the ♂. (Norman, 1953).

*Field identification.* Discal spots underfore on a very even curve. Submarginal spots but no lunules on the underside of both wings, giving an appearance similar to that of *albocoerulea* Moore.

10. **Amblypodia nicevillei** B. Bkr.

This species flies in the Kabaw Valley in April in company with *A. silhetensis*. In view of this, Brigadier Evans, to whom I have shown my specimens, considers that *nicevillei* should be regarded as a good species.

11. **Tros plutonius tytleri** Evans

Two specimens of this species, previously only recorded eastwards from Manipur, have been taken by my collectors in the Naga Hills.

12. **Papilio machaon verityi** Fruh.

My collectors recently sent a specimen of this species, caught in the Naga Hills, to Mr. A. E. G. Best, to whom I am much indebted for the gift of the specimen. It is known to be fairly plentiful on Mt. Saroi in Manipur, but this may be the first record from the Nagas.

13. **Aporia harrietae** De N.

A ♂ taken in the Nagas (near Jhakama) in October 1953 is the first record of any habitat for this species elsewhere than in Bhutan. Compared with Bhutan specimens mine is darker, and all pale areas on the upperside are more restricted.

14. **Mycalesis mnasicles perna** Fruh.

This species flies commonly in the Kabaw Valley.

15. **Chersonesia rahria rahrioides** Moore

This species, whose distribution Evans (1932) gives as Manipur-Burma, is common in the Sibsagar district of the Assam Valley.

16. **Neptis assamica** Moore

This species is listed by Evans (1932) in error as a sub-species of *N. dindinga*. I have caught three specimens of this very rare species in the Sibsagar district in February.

17. **Polytremis minuta** Evans 2 ♂♂

**Scobura woolletti woolletti** Riley 1 ♂

I have taken both of these species, (previously only recorded from Manipur) in the Sibsagar district.

18. **Plastingis sala** Hewitson

1 ♂ Sibsagar district. This species appears to be fairly common in SW. India, but hitherto it has been recorded from nowhere between the West coast and Burma.

19. **Amblypodia apha** De N.

One ♂ from Sibsagar district (Garmpani Reserve) in August constitutes a new addition to the Indian list. Previously only recorded from S. Burma.

20. **Amblypodia alesia** Felder. Several ♂♂

**A. aceta** De N. Several ♂♂.
**A. belphoebe** Doherty One ♂.
**Tajuria isaeus** De N. One ♀.
**Rapala kessuma deliochus** Hew. One ♀.
**Bibasis etelka** Hew. One ♂.

I have taken all the above species in the Kabaw Valley in April, and they must therefore be added to the Indian list.

21. **Plastingia tavoyana** Evans

This species, previously only recorded from Burma, Siam and Borneo, flies in the Kabaw Valley. From the evidence of the one specimen I have caught and shown him, Brigadier Evans considers that the Kabaw Valley specimens will turn out to be at least a new sub-species.

22. **Isma** Distant

I have caught two identical ♀♀ of a species belonging to this genus in the Sibsagar district of Assam. The genus has not previously been recorded from India. My specimens are almost certainly referable to a new species.

Throughout these notes the Kabaw Valley refers to the country on the Indian side of the Manipur-Burma border.

One specimen each of three species formerly unrepresented there has been presented to the National Collection of the Zoological Survey of India in Calcutta. These are :

*Lycaenopsis ceyx cerima* Corbet ♂.
*Thecla kabrua* Tytler ♂.
*Thecla kirbariensis* Tytler ♂.

I am much indebted to the authorities at the Zoological Survey of India (Calcutta) and at the British Museum of Natural History (London) for permission to study material in their charge ; and to Brigadier W. H. Evans and Sir Keith Cantlie for much help and advice.

SELENG TEA ESTATE T. NORMAN.
SELENG HAT P.O., ASSAM
*February* 17, 1956.

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Evans, W. H. (1932) : The Identification of Indian Butterflies.

Norman, T. (1953) : Notes on the Lepidoptera of Assam—II. *JBNHS*, **51** (2) : 515-517.

## 34. THE RELATIVE ABUNDANCE OF THE THREE FEMALE FORMS OF *PAPILIO POLYTES* L. IN CALCUTTA

With reference to Mr. Sanders' note (1955, *JBNHS*, 52: 805), the note of mine, to which he refers, was published in 1944 (*Journ. Beng. N.H. Soc.*, 19: 76) and was evidently based on insufficient material.

In 1947 (*Entomologist,* 80: 172) I published a short note giving a summary of the published accounts of the relative abundance of the three forms, and added the results of my own rearing from eggs collected over a longish period from orange trees in my own and neighbouring public gardens in Calcutta. The collecting was done at intervals of a few days, so that it can be claimed that the results are fully representative of the population. The figures are as under:

| | | | |
|---|---|---|---|
| Males | ... | | 80 |
| Females f. *stichius* | ... | 65 | |
| f. *romulus* | ... | 12 | |
| f. *cyrus* | ... | 18 | 95 |

If anything, the proportion of *romulus* may be a little higher than it ought to be as a batch of some half dozen eggs was once found, obviously the product of a crippled female, and this produced three *romulus* females and three males.

It will be seen that the number of females reared exceeded the number of males. Due to their more retiring habits females are usually less in evidence than the other sex.

Mombasa, D. G. SEVASTOPULO,
*February* 10, 1956. F.R.E.S.

## 35. THE 'SLUG' CATERPILLAR, *PARASA LEPIDA* CR., AND ITS CONTROL

Ananthanarayan and Abraham's paper under this heading (1955, *JBNHS*, 53: 205) omits any mention of what is undoubtedly its most interesting parasite. This is the Chrysidid wasp *Chrysis shanghaiensis* Smith. In 1936, in Calcutta, I found a considerable proportion of the cocoons of *P. lepida* spun on the trunk of a mango tree had been parasitised by the Chrysid, (mihi,—1937, *Proc. R. Ent. Soc., Lond.,* (A), 12: 11).

The Chrysididae, also known as Cuckoo or Rubytail Wasps, belong to the Vespoidae and are normally parasites of other solitary wasps, the parasite larva feeding on the host larva and the insects stored for its food. The direct parasitisation of a Lepidopteron by a Chrysid may give an indication of how the parasitic habits of the more highly specialised Ichneumonidae and Braconidae have arisen. Firstly the collection and storage of insects for food for the larva; secondly the 'cuckolding' of other species of solitary wasp; thirdly the laying of an egg on or near a lepidopterous cocoon, as in the present species;

and finally the highly specialised habits of the modern Ichneumonidae and Braconidae.

As a matter of interest, *P. lepida* is also well known as a pest on both tea and coffee.

MOMBASA, D. G. SEVASTOPULO,
*February* 23, 1956. F.R.E.S.

## 36. INTERESTING OBSERVATIONS ON THE MOUNDS OF THE TERMITE, *ODONTOTERMES REDEMANNI* (WASMANN)

While collecting specimens of the termite *Odontotermes redemanni* (Wasmann) in July 1955 from mounds at Jhargram, a town in West Bengal, some interesting observations on the mounds were made. In course of collection we came across a mound of moderate size, quite uninhabited by any termite. As expected, the Royal chamber was also found to be empty. The mound was, however, full of the ants of the genera, *Camponotus* and *Solenopsis*. Ants are known as one of the termitophilous insects, and about their relationship with the termites Imms (1951)[1] states that they are quite friendly, unless the nest is disturbed. It therefore appears that in the present case the normal relationship between the ants and the termites was somehow disturbed, resulting in the complete possession of the mound by the ants, who overpowered the termites.

Ants, collembola and myriapods were common in all the nests examined, and in addition Cybister larvae were obtained from four mounds out of the total twenty mounds examined at that time.

ENTOMOLOGY LABORATORY,
ZOOLOGY DEPARTMENT, BARUNDEB BANERJEE
UNIVERSITY COLLEGE OF SCIENCE,
CALCUTTA,
*March* 8, 1956.

## 37. THE ESSENTIAL OIL OF *CYMBOPOGON TRAVANCORENSIS* BOR

The new classification of 'white grass', formerly designated *Cymbopogon flexuosus* Stapf. forma *albescens*, as a species (*C. travancorensis* Bor) by Dr. N. L. Bor [*JBNHS*, 52 (1): 175] is fully substantiated by the results of analysis of its essential oil. Details of the analysis were included in a thesis submitted by me in 1953 to the Travancore University and will be published elsewhere. The oil does not contain a detectable quantity of citrol and contains only a relatively small proportion of borneol, the characteristic constituent of some related grasses. Its chief constituent (*ca.* 40%) is not a terpene derivative at all but a benzenoid compound elemicin. Elemicin has not yet been reported in any Indian *Cymbopogon* oil though it occurs in two foreign grasses, *C. georingii* and *C. procerus.*

---

[1] Imms, A. D. (1951): A text book of Entomology, New York.

'Malika'
Kuruppam Road,
Trichur,
*April* 10, 1956.

T. C. K. MENON

## 38. A SPECIFIC FOR LEUCODERMA

(*With two figures*)

Leucoderma (Vitiligo) is a disease caused by the absence of the pigment 'melanin' from the affected portions of the skin of human beings. The disease, though looked on with alarm by a great majority of the people, is unlike leprosy neither contagious nor hereditary. The available data on the prevalence of the disease in India indicates that the incidence of the disease is on the increase. It is also noticed that men suffer more from this disease than women, the proportion of affected men to women being roughly in the ratio of 15:1.

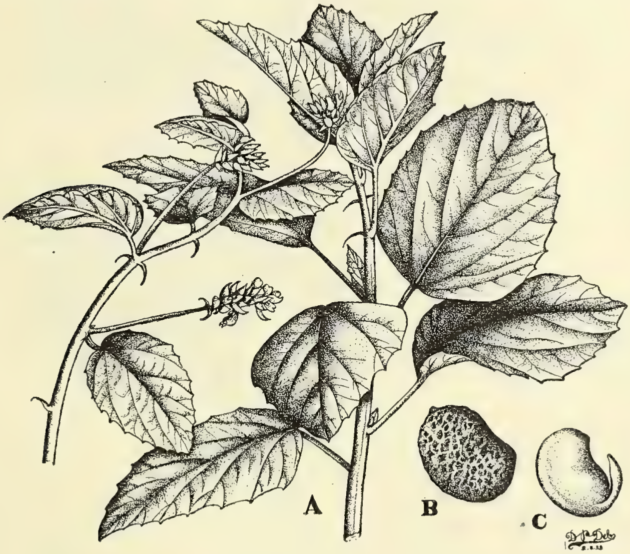

Fig. 1.

*Psoralea corylifolia* Linn.

A.—Portion of a flowering twig.
B.—Mature seed showing the characteristic markings on the seed-coat.
C.—Mature seed with the seed-coat removed.

Various specifics are known to have been tried in the treatment of this disease, but the results have not been found to be very encouraging. Certain oleo-resinous extracts, essential oils, psoralen-isopsoralen mixture, leudermol, liq. hydrarg-perchloride and oil of Baichi (*Psoralea corylifolia* Linn.) are some of the medicines generally prescribed in the treatment of this disease. Among all, the herbaceous plant *Psoralea corylifolia* Linn. (family Leguminosae)—(fig. 1-A) has gained importance. This plant grows generally in a wild state in the plains throughout India. Its tiny seeds which are brownish black in colour (fig. 1-B) have an agreeable aromatic odour and are bitter to the taste. The seeds are much used in the treatment of leucoderma. Chemically, the seeds contain a resin, an essential oil, a terpenoid oil, and two crystalline principles called *psoralen* and *isopsoralen*, to which are attributed the anthelmintic and antidermatic properties of *Psoralea corylifolia* Linn.

In the present note I mention a specific prescribed by a fakir which, from my personal and intimate knowledge of its application to two patients, has brought marvellous results. The patients treated were one a boy of 17 years and the other a middle-aged man of 35 years, both acute cases of leucoderma.

The basic materials used in the medicine are the seeds of *Psoralea corylifolia* Linn. (vern. Babechi, Babachi, Baichi), *Cicer arietinum* Linn. (the common gram), and fresh mature leaves of *Melia indica* Linn. (the common Neem tree). Equal quantities, say 1 seer of each of the above materials, are boiled in water sufficient to cover the materials for 7-8 hours in a suitable container, preferably with a wide mouth. After boiling thus for about 7-8 hours, and when the water has almost evaporated, the neem leaves alone are removed carefully and discarded. The remaining portion consisting of the boiled seeds of *Psoralea corylifolia* Linn. and *Cicer arietinum* Linn. are then spread out and dried in the open shade for 3-4 days on any suitable tray or plate, previously scrupulously cleaned. After drying completely for 3-4 days, the dried material is then kept inside a cavity scooped out of the main trunk of a fairly large Neem tree. This cavity (fig. 2) is to be at least 3-4 inches in diameter and 2-3 inches deep. The mouth of the cavity is covered by a tin plate. The material is left in that cavity for at least 2½ to 3 months, after which it is taken out and dried again in shade in the open for about 3-4 days. It is then powdered and preserved in a well-corked container. The powder thus prepared constitutes the specific. The dose prescribed is 1 (one) tea-spoonful of the powder with ½ cup of water to be taken on an empty stomach, every morning.

The medicine, when administered to the two cases referred to earlier, showed very encouraging results even within a month of their treatment. The white patches on the skin at first gradually turned to red or light red. Later small dark spots appeared on the affected portions, and these spots gradually increased, ultimately completely obscuring the white patches and turning the skin quite normal. The formation of any fresh patches or spread of the infected portions of the patients were also found effectively arrested. The two patients are now completely cured, without any trace of their past ailment.

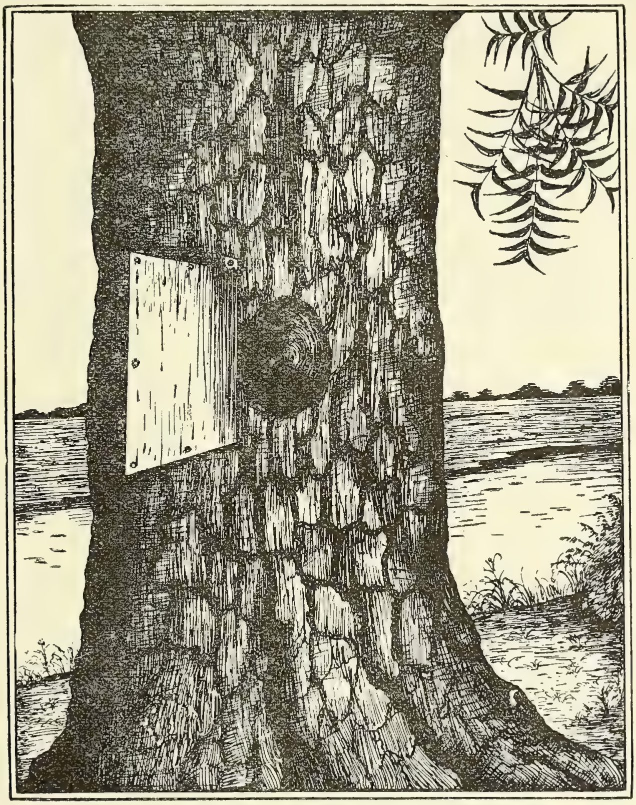

**Fig — 2**

Sketch of a portion of the mature stem of Neem tree showing the scooped portion where the boiled and dried seeds of *Psoralea corylifolia* Linn. and *Cicer arietinum* Linn. (the common gram) are kept in the preparation of the specific.

In conclusion, I express my grateful thanks to Sri K. S. Srinivasan, Curator, Industrial Section, Indian Museum, Botanical Survey of India, for his kind criticism of this note.

INDUSTRIAL SECTION,
INDIAN MUSEUM,
BOTANICAL SURVEY OF INDIA,
CALCUTTA,
*June* 5, 1956.

A. BASU, M.SC.

## 39. WILD LIFE PRESERVATION IN INDIA

I was interested to read the letter by Colonel R. W. Burton (52: 923) on the preservation of wild life in what he calls the former Gilgit Agency. I was up in these parts only last year where I spent a considerable time in climbing and trekking. I am, therefore, in a position to say something on some of the points raised:

(1) Marco Polo's sheep is still found in Hunza State where the Mir exercises a fairly good protection over the wild life of his territory.

(2) As regards trout the river Ghizr has plenty of this fish, specially in the area between Gupis and Ghizr. As a keen fisherman himself, the Raja of Gupis protects the fishing in his area with great success. Consequently, trout have flourished and a good amount of fishing can be enjoyed above Gupis at Pingle, Phandar and Ghizr. These trout run to quite a big size. Above Ghizr there are not many fish as the river becomes smaller as one goes higher. Actually good fishing starts just a few miles from Gilgit itself. I had plenty of it all the way from Gilgit to Ghizr—a distance of about 90 miles. Up to Gupis one can now ride in a jeep, and then a mule track which I followed over the Shandu Pass into Chitral.

There is no doubt that great damage has been done to wild life on the whole in all the northern areas and strict protection is badly needed to conserve it, but there is still quite a lot. I saw markhor, ibex, and even a skin of a freshly killed snow leopard was brought to me. I was told by the locals that there are quite a few of them still in existence.

EMBASSY OF PAKISTAN,
WASHINGTON, D. C.,
2315, MASSACHUSETTS AVENUE, N.W.,
*January* 9, 1956.

M. HAYAUD DIN,
*Maj.-Gen.*

## 40. ON THE NAMES FOR CERTAIN BIRDS RECENTLY ADOPTED BY THE INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

The International Commission on Zoological Nomenclature has recently taken a series of important decisions on the names for certain birds regarding which applications to the Commission were published in October 1952 in Part 1/3 of volume 9 of the *Bulletin of Zoological Nomenclature*. Among the decisions so taken the following are of wide general interest:—(1) suppression of the generic name *Colymbus* Linnaeus, 1758, and acceptance of the generic name *Gavia* Forster, 1788, for the divers (loons), and of *Podiceps* Latham, 1787, for the grebes (*Opinion* 401); (2) validation of the generic name *Pyrrhocorax* (Tunstall), 1771, for the Chough by the suppression of the name *Coracia* Brisson, 1760 (*Opinion* 404); (3) suppression of the specific name *ericetorum* Turton, 1807, and acceptance of the name *philomelos* Brehm, 1831, for the Song Thrush (*Opinion* 405); (4) suppression for nomenclatorial purposes of the names by Linnaeus published in 1776 in the 'Catalogue of Birds, Beasts, . . . in Edwards' Natural History' (*Opinion* 412; (5) validation of the name *Columba migratoria* Linnaeus, 1766, for the Passenger Pigeon (*Direction* 18); (6) validation of the generic names *Bubo* Dumeril, 1806, *Coturnix* Bonnaterre, 1790, *Egretta* Forster, 1817, and *Oriolus* Linnaeus, 1766, by the suppression of older homonyms (*Direction* 21); (7) acceptance of *Gallinago* Brisson, 1760, and rejection of *Capella* Frenzel, 1801, as the generic name for the Snipe (*Direction* 39). The foregoing *Opinions* and *Directions* are now in the press and will be published at an early date. All enquiries should be addressed to the Publications Officer, International Trust for Zoological Nomenclature (address: 41 Queen's Gate, London, S.W. 7).

41, Queen's Gate,
London, S.W. 7,
*April* 18, 1956.

FRANCIS HEMMING,
C.M.G., C.B.E.
*Secretary, International Commission on Zoological Nomenclature.*

# GLEANINGS

## How Camels Conserve Water

It has long been known that the camel can survive hard work in the heat of the tropical desert for a long period without water, but how this is done has been a mystery. Ancient lore said that the water was stored in the hump. This is impossible because the hump is solid. Later it was said that he drank an abnormal quantity of water which was stored in one of his multiple stomachs similar to those of the cow. This is not correct as the camel does not drink large quantities of water until after he has been well dried out. Dr. Knut Schmidt-Nielsen, Professor of Zoology at Duke University in the U.S.A., directed the study and reported the results to the UNESCO Advisory Committee on Arid Zone Research. The research had been sponsored by UNESCO, the Guggenheim Foundation, Duke University and the U.S. Government.

The camel's unique ability to go without water turns out to be the result of half a dozen extraordinary properties that are not shared by any other animal. He cannot store the water as such but it is conserved in the following ways:

(1) His excretions are very low in water content, while those from his kidneys only amount to ¾ oz. per hour, less than a pint per day, even when he can drink all he wants.

(2) The camel does not cool himself by evaporating water from his skin by sweating, or from the tongue and respiratory tract by panting. He has a pattern of sweat glands widely distributed over the skin, but these come into play only when the body temperature reaches danger point and then secrete no more water than is absolutely necessary. Accordingly the body temperature can rise from 93° F. to 104°F. without any ill-effects to the animal.

(3) When the camel loses water under prolonged heat and when the body temperature is well above normal, he does not lose water

from his blood stream and the concentration of blood plasma remains close to normal.

(4) The camel's thick fur is an additional protective device. With all these protective devices in cool January weather the average loss of body weight is 0.9 per cent of the camel's weight per day; in a hot June it is 2.2 per cent. By contrast, the donkey loses 3 per cent per day in January and 7.7 per cent per day in June.

(Adapted from UNESCO Report in *Pakistan Journal of Science* Vol. 7 No. 4, July 1955. Pp. 209-10.)

## *Without Comment.*

Maharaja Ramanuj Saran Singh Deo, Maharaja of Surguja, in a note on 'Tiger Hunting in India', *Journal of the Bengal Natural History Society,* April 1955, xxvii (3): 98 states: " have shot 1,111 tigers and over 2,000 panthers. I have hunted in Surguja, Madhya Pradesh, Uttar Pradesh, Assam, Nepal, Rajasthan and Vindhya Pradesh. . . . My highest bag of tigers is 5 in a beat in five shots and 11 panthers in one night.'

## *Songs of Cicadas.*

In *Spolia Zeylanica* 27 (II): 229-39 (1955) is an article on 'The Songs and Habits of Ceylon Cicadas, with a Description of Two New Species' by J. W. S. Pringle, Department of Zoology, Cambridge.

In the course of an investigation of the physiology of sound production 'it soon became clear that the characteristic song pattern, once recognised, can be used to give positive identification of the species in the field.' . . . 'Field recordings of the songs of the nine species were made with an M.S.S. Magnetic Tape Recorder, Type PMR/1, operated from a car accumulator through a vibrator power supply. This instrument records with little distortion the song of the larger species, whose sound spectrum falls mainly within the range audible to human ear. . . . Slow oscillograms of the songs are shown in Plate 1.'

## *A Strange Fish Habit.*

Prof. J. L. B. Smith of Rhodes University, Grahamstown, South Africa in a letter in *Nature* (14 April 1956), p. 714 records a *Gobius bibarbatus* caught in a tide pool near Swakopmund, which blew itself up in the same fashion as a Tetraodon (puffer fishes).

It is interesting to speculate what ecological or other factors have tended to produce this most extraordinary habit.

Extracts from 'GOLD SPORT AND COFFEE PLANTING IN MYSORE' by Robert H. Elliot (published in 1894) dealing with his experiences as a coffee planter in Mysore for 38 years after 1855.

*Page* 93, 94.—He confirms the 'native' view that 'the bear is more dangerous than the tiger, and the panther much less dangerous than either'. Quoting from the North Kanara Gazetteer, he states that 'during the 22 years ending 1887, 510 tigers were killed and 44 persons killed by them. Between 1856 and 1882, 51 bears were killed and 22 persons killed by them.' He calculates that 'the bear is therefore about four times as dangerous as the tiger, the tiger is about three times as dangerous as the panther and the bear is about fourteen times as dangerous to man as the panther.' Regarding comparative destructiveness to animal life, he observes that 'the tiger seems to be more troublesome than the panther and between 1878 and 1882, 4041 heads of cattle were killed by tigers as against 1617 by panthers.'

*Page* 96.—He quotes the Mysore Gazetteer (Vol. 2 p. 13) that 'according to old legends the lion was once found in that Province.'

*Page* 126.—A shikari had just tried to climb a tree, but been unsuccessful. 'The tiger presently emerged from the jungle, went to the tree and began roaring and scraping at the ground, and he must have either smelt traces of the manager or seen him trying to get up into it, and concluded he was there. However, he deliberately went up the tree paw over paw, and got into a cleft of it and looked about in the tree, and then came down backwards, and was shot in the act of descending.'

*Page* 135.—' A tiger flew at a Hindoo peasant—a first-rate plucky sportsman, and as the tiger charged, the man struck at it with his hacking knife (a formidable weapon in the hands of a man who knows how to use it, and used to cut underwood, and thick boughs of trees), with the result that the tiger's skull was split open and the animal killed on the spot. The native was thrown backwards with force, and his head came in contact with a stone. He got up, and by this time was surrounded by the people, when, holding out his hand, he said, 'Look here', and then paused. Everyone expected some remark about the tiger, but, amidst general laughter—for the natives have a keen sense of humour—he continued, "There will be a bump on my head tomorrow as big as a coconut".'

*Page* 138.—'In all the books I have read about tigers I have never met with an allusion to tigers purring like cats from satisfaction, but a brother planter informs me that he heard a wounded tiger, that had killed one of the natives who was following him up, purr for several minutes, as he described it, "like a thousand cats".'

*Page* 140, 141.—'The bear breeds much slower than the tiger and that is why they are so soon almost exterminated. In Belgaum between 1840 and 1880, 223 bears were killed. The steady decline of the numbers of the bears is shown by the fact that 137 were killed between 1840 and 1850, 51 between 1850 and 1860, 32 between 1860 and 1870, and 3 between 1870 and 1880. In Kanara 51 bears were killed between 1856 and 1882.'

*Page* 158.—'From what I have known of the habits of the wild boar, I do not think I should ever be inclined to partake of its meat, and certainly not when cholera is about. A neighbour of mine told me that when he was once beating a jungle for game the natives backed out of it with great promptness, having come upon wild pigs in the act of devouring the dead bodies of some people who had died of cholera . . . . An official of the Forest Department told me that, passing one day near the place where the carcase of an elephant lay, he had the curiosity to go and look at it. To his astonishment he found the flanks heaving as if the elephant were still alive, and while he was wondering what this could mean, two wild boars, which had tunnelled their way in, and were luxuriating on the contents of the carcase, suddenly rushed out.'

*Page* 159.—'In the 1876-77 famine the wild dog grew very bold in Kanara and killed great numbers of half-starved cattle which were driven into the forest to graze, . . . . A widespread belief is that the dogs first of all micturate on each other's bushy tails, and, when rushing past the tiger, whisk their tails into his eyes and thus blind him with the objectionable fluid, after which they can attack him with comparative impunity. A forest officer informs me that the Gonds have a somewhat similar tradition, and that they believe that the dogs first of all micturate on the ground around the tiger, and that the effluvium has the effect of blinding him.' (In a footnote he adds that Jerdon who heard a similar story in Nepal disbelieves it.)

*Page* 162.—'I have good reason to suppose that the immense number of deaths (sometimes returned at 17,000 or 18,000 for all India) reported as being caused by snake-bite, are really poisoning cases which are falsely returned as being due to this cause . . . . In my own long experience, I have not only never known of a death from snake bite on my estates, but have, since 1855, never heard of but one case in my neighbourhood, and that was of a boy who was killed by a deadly snake about four or five miles from my house.'

*Page* 166.—'The tank snake, often from 9 to 10 feet long, is not only harmless but useful, as it lives so largely on rats and mice, and is in consequence sometimes called the rat snake. On one occasion a manager shot one of these snakes near my house, and it had a rat in its mouth when killed, and such snakes, so far from being killed, ought to be carefully protected . . . . I was interested in observing the proceedings of one of these snakes when followed up by two dogs of mine in the open. First of all, it made for a clump of two or three scrubby trees, and, apparently first fastening itself by the neck to a stump, lashed out with its tail. Then when the dogs came closer it again made off through the grass, but on being overtaken by the dogs must have either bitten one of them, or lashed it with its tail, as the dog gave a sharp cry and retreated.'

*Page* 173.—'Anything more foolish and barbarous than the killing of cow bisons cannot be conceived, for there is not a more harmless and inoffensive animal in the jungle than the bison—harmless because it seldom attacks crops (I have never known of more than one instance of their doing so), and inoffensive because, if not molested, it never attacks man.'

*Page* 177, 178.—'A neighbour, Mr. Park, caught a male calf bison which was supposed to be about three days old. About a week later a young doe sambar, which was being pursued by jungle dogs, rushed into one of the labourers' huts and was secured. The two were kept together, though they were never shut up. They were first of all fed on milk, and then allowed to graze, and soon became quite inseparable companions. They were fed at twelve o'clock and at four in the afternoon, and seemed to know their feeding time exactly. When about two years old a nose rope was fitted on to the bison and it was led out to graze. The sambar sometimes remained behind, but seemed to have no difficulty in finding the bull even though it had been taken to a considerable distance. It would hold up its nose to catch the scent and then go off on the track. When the bison occasionally missed the doe he would wander about in search of her, but seemed to have no power of following her by scent—a power which she evidently possessed and practised. When the bull was about three years old it was presented to the Maharajah of Mysore, and sent off to the nearest railway station some sixty miles away. Some time after he had left, the doe discovered his absence, and then, in her usual way, went about holding up her nose in order to discover the direction in which he had gone. Presently she hit off the route and, setting off in pursuit, overtook her old companion after he had gone about five or six miles and, though the doe had not been given to the Maharajah, she was allowed to accompany the bull. When the doe overtook the bull he showed the greatest signs of pleasure at her arrival, and the two travelled happily along to Mysore.'

## NOTES AND NEWS

At the instance of the Bird Wing, Indian Board for Wild Life, Mr. Sálim Ali undertook an investigation of the alleged detrimental effect of the Kandla-Deesa railway embankment across the Little Rann of Kutch on the breeding grounds of the flamingo in the Great Rann. The investigation revealed that the bund in no way interferes with the amount of water discharged into the Great Rann by the rivers to its north, and that the requisite hydrological conditions continue, as before, to depend mainly upon the SW. Monsoon. Flamingoes had bred in large numbers in the Great Rann after the satisfactory rainfall of the 1955 season, and it appears that a deficient monsoon is really what produces the adverse conditions that inhibit breeding. Fortunately the railway embankment seems to have nothing or little to do with the non-nesting of the birds that has been reported in a series of recent years.

* * * *

Dr. M. L. Roonwal, M.SC., Ph.D., F.N.I., F.Z.S.I., Forest Entomologist, Forest Research Institute, Dehra Dun, and a member of the Society's Advisory Committee has been appointed Director of the Zoological Survey of India in place of the late Dr. S. L. Hora.

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3. All scientific names, to be printed in italics, should be underlined. Both in zoological and in botanical references only the initial letter of the genus is capitalized. The specific and sub-specific names always begin with a small letter even if they refer to a person or a place, e.g., *Anthus hodgsoni hodgsoni* or *Streptopelia chinensis suratensis* or *Dimeria blatteri.*

4. Trinomials referring to subspecies should only be used where identification has been authentically established by comparison of specimens actually collected. In all other cases, or where identification is based merely on sight, binomials should be used.

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Roepke, W. (1949): The Genus Nyctemera Hübner. *Trans. ent. Soc. Lond.*, **100** (2): 47-70.

Prater, S. H. (1948): The Book of Indian Animals, Bombay.

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